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ENGINEERING NEWS.

A SHIP CANAL AROUND NIAGARA FALLS has been favorably reported upon by the House Committee on Railways and Canals. The bill provides for a ship canal built by the United States around Niagara Falls. The definite location is to be made by a board of five men appointed by the President, two of them to be army engineers, two civil engineers, and one "well known citizen." The bill would appropriate $1,000,000 to commence work, though the estimated cost on present plans is $23,000,000. The new canal would be 21½ feet deep, 23 miles long, and the locks would be 400 by 80 feet.

THE CORINTH CANAL WORKS are to be again resumed, and bills authorizing a company to raise $800,000 for their completion have just passed their third reading in the French Chamber of Deputies.

THE IRRIGATION QUESTION is assuming importance in Victoria, Australia. The Irrigation Conference was opened at Melbourne, March 25, and was largely attended by engineers and experts. The Hon. A. DEAKIN, Chief Secretary and Commissioner of Water Supply, who presided, stated that 25 irrigation trusts had now been established, to which $1,400,000 had been advanced by the State on land, in trusts valued at $20,000,000. No works had yet been completed, but some would be ready by next season. The chairman added that the prospects were quite as good as in Western America, where splendid results were being obtained. A number of papers were read, contributed by members of the conference, giving details of individual successes in irrigation in Victoria.

A TRANS-SAHARA RAILWAY is being discussed in France, from a strategic, political and commercial point of view, rather than from that of engineering feasibility. The route has been outlined from Algeria to the western and central Soudan.

THE STREET-PAVING EXPOSITION at Indianapolis has resulted in bringing together quite an elaborate display of exhibits from the street-paving companies. These include asphalt, stone-paving and many varieties of brick for street paving. A. O. Jones & Co., of Louisville, O., exhibited a paving brick glazed on the upper surface and grooved on the sides in diagonal or vertical lines; this brick is to be laid in pitch, and is claimed as satisfactory in use. The Haydenville Mining & Manufacturing Co., of Columbus, O., and the Adams Brick Co., of Indianapolis, also had very creditable exhibits of paving brick for streets. Vitrified tiles and brick for sidewalks were abundant. The managers of the exhibition have decided to make it permanent.

FREE INSTRUCTION IN ROAD MAKING is offered by the Case School of Applied Science, of Cleveland, O., of which Mr. CADY STALEY is the President. The instruction is to take the form of free lectures on the following topics: Location and construction of roads; keeping up and repairing roads; ditching and drainage; road-making machinery; improvement of the surface of roads, including the use of gravel, broken stone, plank, paving, etc.; highway structures, including retaining walls, culverts, bridges, etc.; cost of earthwork and mechanical structures; highway administration, and laws relating to highways.

NEW STREET CLEANING RULES FOR NEW YORK, as issued by the new Commissioner, Mr. BEATTIE, can be outlined as follows: The Deputy Commissioner is ordered to reapportion his several districts so that each portion will have about the same number of square yards to be cleaned, equal to one man's work. He is then to organize a force of 350 laborers or sweepers. These men must be able-bodied, of good character, are to be not over 55 years of age, and to be citizens of the United States. The laborer must, before appointment, make affidavit that he has not, directly or indirectly, given or promised any part of his pay to other parties (this ruling is intended to stop the "farming out" of Italian and other labor). Said laborers are to be assigned to the divisions noted, and must sweep their apportionment daily. Each man is to be provided with a wheelbarrow, broom, hoe, shovel, and such number of covered receptacles for sweepings as found necessary. The receptacles, as filled, are to be emptied into carts traversing specified routes. The general order defines districts, the times of cleaning, the marking of tools and receptacles, etc.

TUNNELING THE SIERRAS is again being discussed, and the late snow blockade is used as showing the urgent necessity for this work. The San Francisco *Journal of Commerce* says that Senator STEWART has introduced an amendment to the railroad funding bill having this object in view. He proposes that, instead of paying the government sums due in installments, the Southern Pacific will lump this sum and use it in part payment of tunnels. The plan of the engineers is to tunnel at least 1,000 ft. below the deep snow-line. The start would be made at Cold Spring Cañon, just west of Truckee, and come out at Yuba River Cañon. About 10 miles of tunneling would be required, and a rise of 1,000 ft. saved on each side of the mountain. The estimated cost is $10,000,000.

THE EAST RIVER TUNNEL PROJECT is apparently making progress, and it undoubtedly is being pushed with energy. It has been long obstructed in the bridge and tunnel committee of the New York Board of Aldermen, and the projectors of the tunnel propose to know the reason why.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of an express train on the Wabash R. R., near St. Charles, Mo., April 4. The accident is attributed to spreading of the track. Five cars went down the bank, but by great good fortune no one was killed, and only one seriously injured; about a dozen persons were cut and bruised more or less.——A somewhat similar derailment occurred April 2 at Guthrie, Ky., on the Henderson Division of the Louisville & Nashville R. R. The engine was overturned and the passenger cars collided with some freight cars on a side track. The engine driver was the only person seriously injured.

A LANDSLIDE occurred April 6 on the West Shore R. R., near St. Johnsville, N. Y. A freight train was wrecked.——A large rock fell on the track of the New York Central R. R. in a deep rock cut 1¼ miles south of Garrisons, N. Y. The watchman ran south to warn a freight train, but was not in time to prevent an accident: the engine and about 12 or 15 cars were wrecked, but no one was killed. The watchman's wife went north and warned an express passenger train in time.

BRIDGE ACCIDENTS are reported as follows: On March 27, the Dugan highway bridge near Merced, Cal., gave way under a team.——The bridges of the Louisville, New Orleans & Texas R. R., at Clayton, Miss., and over Bayou Falaya, were swept away April 2.——Terrill's bridge, over the Shepaug river, near Roxbury Station, Conn., gave way April 3, under a wagon load of ties for the Shepaug R. R.——At South Boston, Va., on April 4, a sudden gale blew down a partly erected span of the new iron bridge carrying the Lynchburg & Durham R. R. across the Dan river.

CYCLONES AND HEAVY STORMS are reported from Illinois, Ohio and Michigan, with much damage caused to buildings, etc. Several electrical storms have occurred in the vicinity of New York.

CONTROL OF THE UNION PACIFIC RY. CO. is reported to have been secured by the Vanderbilts, who it is expected will assume the management of the property partly or in full at the next annual meeting, to take place in a short time. A traffic arrangement is already in operation between the Vanderbilts' Chicago & Northwestern R. R. and the Union Pacific Ry. The importance of this alliance, especially when backed by a common proprietary interest in the roads, is great, as a complete trans-continental line is thus formed. This, together with the fact that such an alliance without the common proprietary interest would be likely to last but a short time, seems to give a sound of reason to the reports.

COMPOUND LOCOMOTIVES will probably be given extensive trials in this country. The latest news in this direction is that the East Tennessee, Virginia & Georgia Ry. has given an order to the Schenectady Locomotive Works for three compound engines on the Mallet system, with two cylinders. Two of these will be consolidation freight engines, with cylinders 20 × 24 ins., and 29 × 24 ins.; the third will be a ten-wheel passenger engine, with cylinders 19 × 24 ins., and 27 × 24 ins. Apart from being compounds, these engines are duplicates of each type now being built for this railway at the same works, and are being built to the designs of Mr. A. J. Pitkin, superintendent of the works. The list of compound locomotives in this country now includes the ten-wheel engine of the Michigan Central R. R., Mallet system; the eight-wheel engine of the Baltimore & Ohio R. R., with four cylinders; the English engine of the Pennsylvania R. R., Webb system, with three cylinders; a new passenger engine being built at the Altoona works of the Pennsylvania R. R.; a passenger engine for the Old Colony R. R., Mallet system; and the three new engines for the East Tennessee, Virginia & Georgia Ry. The Mexican Central Ry. is having a compound engine built; and the Grand Trunk Ry., of Canada, has one or more compounds. In addition to these, Mr. GEORGE S. STRONG, the inventor of the Strong locomotive, has patented designs for the application of the compound system to his engines. The new Pennsylvania R. R. engine will be on the Mallet system, with cylinders, 19 × 24 ins. and 27 × 24 ins., and driving wheels 68 ins. diameter. It will be completed in about four months.

THE THREE-BLADED PROPELLOR lately substituted for four blades in the twin screws of the Hamburg-American steamship *Augusta-Victoria* has so increased her speed that she is reported as averaging 20 knots in an 8-hour trial near Hamburg. The *Columbia*, of the same line, which is now claimed to be faster than the *City of New York* or the *Teutonic*, is also to have twin three-bladed propellors.

THE TOWER BRIDGE, crossing the Thames in London, has the foundation of its north river pier 19 ft. above H. W. and the south pier 9 ft. The northern and southern approaches are nearly completed, excepting only the parts around the anchorages. False works are being erected for the building of the north shore span.

THE JAMES B. EADS CONCERT, lately held in St. Louis, under the auspices of the Liederkranz and the Choral Society, has netted several thousand dollars. This is the begining of the fund to be raised for the erection of a fitting memorial of MR. EADS in St. Louis.

AN ELEVATED RAILWAY ON ATLANTIC AVE., BROOKLYN, is now definitely decided upon instead of the sunken tracks lately approved of. The Rapid Transit Commission of Brooklyn, at its last meeting, after making a few amendments, finally passed the elevated plan. The most important amendment was to allow posts in the street, provided a passage of 15 feet was left between the posts and the curbs. All is ready now to form a company and begin work.

A LOW-PRESSURE, COMPRESSED AIR STREET CAR has been invented by Hughes & Lancaster, engineers, of Chester, England. The chief departure from the methods of Col. BEAUMONT, MEKARSKI and other inventors is that instead of carrying air at a high pressure in large and heavy reservoirs for a considerable distance, the reservoir on this car is ⅛ in. thick and comparatively small, and it "picks up" a fresh air supply at half-mile interva s. Messrs. Hughes & Lancaster use 170 lbs. per sq. in. as a maximum pressure. Along the line of the route a main pipe line is laid with branches leading to boxes at every half mile. The car reservoir is charged automatically in a fraction of a minute at these stations, the car stopping meanwhile. The car weighs in total, with machinery, air reservoir and passengers, 5 tons 9 cwt. The average speed of an experimental car was nine miles per hour, with 15 miles attained as a maximum. It has been tested on severe gradients.

THE CHILIAN NITRATE BEDS are estimated by M. C. LAGRANGE to cover 89,177 hectares, or 35,671 acres, and to contain 2,216,000,000 metric quintals, at 220 lbs. to the quintal. Of this amount 1,471,000,000 metric quintals are in private hands and the remainder belongs to the State. This estimate includes the Tarapace, Antofagasta, Agnas Blancas and Taltal regions.

THE EXACT DATE OF THE DESTRUCTION OF POMPEII is a subject of contention owing to discrepancies in the accounts of the elder PLINY and other authorities. One of the late discoveries in the ruins is an exact imprint of a shrub, absolutely intact in leaves and branches. A cast of this has been made, and a specialist in botany declares that it is a species of laurel which does not fully ripen in that part of Italy until the end of autumn. The conclusion drawn from the appearance of this plant is that the eruption occurred about Nov. 23 instead of on Aug. 24, the usually accepted date.

A KANSAS CITY publication, backing up its statement by a page or so of figures, publishes the following, which certainly makes a good showing for that intensely live town:

FACTS ABOUT KANSAS CITY.

Compiled from official authorities by the Kansas City Clearing House, 1889.

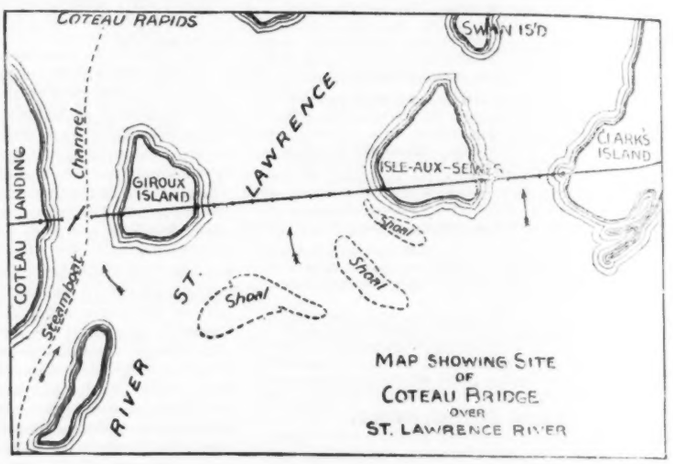
18th in Population.—12th in Banking Capital.— 10th in Bank Clearings.— 9th in Amount of Mail Matter Handled. - 5th in Volume of Telegraph Business.—3d in Transfers of Real Estate.—2d in Number of Railroads at Union Depot.—Second in Volume of Union Depot Business.—2d in Live stock business.—Second in Packing House Business. - 2d in Inner Registered Mail Business.—1st in Percentage of Profit from Post Office. - 1st in Cable Railway Mileage.—1st in Number of Telephones in Proportion to Population. —1st in Number of Calls per Telephone.—1st in Extent and Resources of Tributary Territory.—1st in Volume of Agricultural Implement Business.—1st in Sales of Pullman Car Tickets.— 1st in Business Activity and Prospects.—1st in Opportunities for Investment.

BRICK STREET PAVING.—In our issue of March 29, in publishing a report on street-paving material for Detroit, we inadvertently credited the Canton, O., Fire Brick Co., with the paving of Euclid Place in Cleveland, O. This work was done, in fact, with the brick furnished by the Porter Union Works, of Pittsburg, Pa., as is almost self-evident from the preceding text. In this connection we notice that Mr. F. L HOGE, City Engineer of Wheeling, W. Va., says that the principal streets of that city are now paved solely with the same Porter Union fire-brick The wearing qualities are reported as excellent, and the pavement put down in the summer of 1883 has not needed any repairs. This particular pavement has been traversed by a horse railway for five years of its existence, and even on a steep grade and on a sharp curve no renewals have been made. Mr. HOGE gives the brick an unqualified approval when laid on properly prepared foundation.

The Coteau Bridge.

The third bridge to span the St. Lawrence river has been lately opened for traffic. The cumbersome ferry which has been employed by the Canada Atlantic Ry. Co. for the transportation of cars across the river from Coteau Landing, Quebec, to Clark's Island, was found too slow and tedious for the company's steadily increasing business, and it was decided that a bridge should be erected to supersede the annoying "Transfer." Whether from an engineering or commercial view the Coteau Bridge must create general interest.

The site selected for the bridge, about 37 miles west of Montreal, while it possessed advantages of vast importance to the company on the score of economic location, possessed also numerous disadvantages from an engineering point of view. In the north channel, where the swiftest current runs, the anchorage was treacherous; and, on account of navigation, the course of steamboats and rafts running the rapids had to be kept clear, and the plant used in construction was in constant peril of being run into. In the middle channel, above the center line of the bridge, were three immense shoals stretching diagonally across the channel, and, scattered promiscuously between these were huge boulders, over which there was little water; in the south channel the water was deep, the current swift, and, like in the north channel, the anchorage treacherous. Little trouble, however, was experienced by the fluctuations of water level, which do not vary more than two feet. Being immediately above the Coteau Rapids, the velocity of the water is high, varying in the north and south channels from six to nine miles, and in the middle channel from three to five miles an hour, according to the direction of the wind; a strong east wind holding the water of Lake St. Francis back, reduces the current to its minimum velocity, while a heavy gale from the west or southwest produces the other extreme.



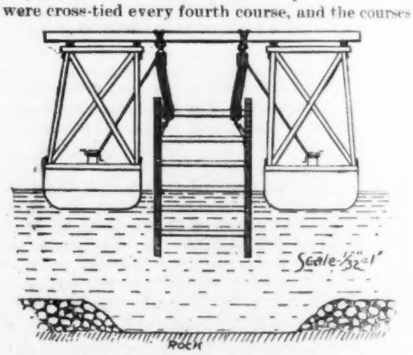
The banks on either side of the river, and the islands intervening, are low and slope gradually toward the water, and it was on this account that a low-level bridge, with a draw over the steamboat channel, was decided upon. The river bed between Lake St. Francis and Lake St. Louis, or through the Coteau, Cedars, Split-rock and Cascades rapids, is known to be solid rock; where the current is less swift, a thin covering of gravel, boulders and clay worn from the islands, has been deposited above the rock. The width of the river at the bridge site is, on account of the islands, narrower than at any other point in the vicinity; the steamboat channel, from the north shore to Giroux Island, is 844 feet; the middle channel, from Giroux Island to the Isle-aux Seines is 2,170 feet; and the south channel, from Isle-aux-Seines to Clark's Island, is 892 feet; and Clark's Island is connected with the mainland on the south shore by a dam.

Toward the fall of 1888, the contract for the substructure was awarded, and it was intended at the time to build some of the piers that fall, if practicable. Everything in the way of plant for the undertaking had to be provided, a system of operation inaugurated, involving many difficulties and uncertainties, and it was late in the month of September of that year before the plant to make a beginning had arrived.

The excavation of the foundations to the rock was the first step, and for this purpose a dipper dredge was used. The work was laid out by triangulation, and the dredge was first placed over the foundation of the pivot pier. Before dredging, the water was here found to be 24 ft. deep, and the rock 5½ ft. below the bed of the river. To do this successfully with a dredge pinned up on anchors or spuds, in a swift current, required very careful management and extraordinary precaution.

Frequently during the progress of this work spuds of 18 × 20 ins. of blue oak were snapped off like twigs. The foundation for the pivot pier was taken out without any remarkable incident, and the dredge was lined up on the ranges for the up-stream rest pier on Oct. 14 of that fall. At daylight on the morning following, the last raft of the season—of heavy oak—ran into the dredge and sunk it in 28 ft. of water. The delay which this necessarily occasioned, aggravated by the severe weather then setting in, dispelled all hopes of laying masonry that fall. Every preparation was then made for an early start as soon as the ice left the lake in the spring, and on May 16, 1889, the first caisson was floated into position.

With the exception of the pivot caisson, which was octagonal, 36 ft. in diameter, the caissons were 20 x 66 ft., built of 12-in. square hemlock, and were pointed at both ends and bottomless; the up-stream end presented an angle of 45 degs. to the current, and the down-stream end was a more acute angle, to prevent the formation of an eddy. The caissons were cross-tied every fourth course, and the courses



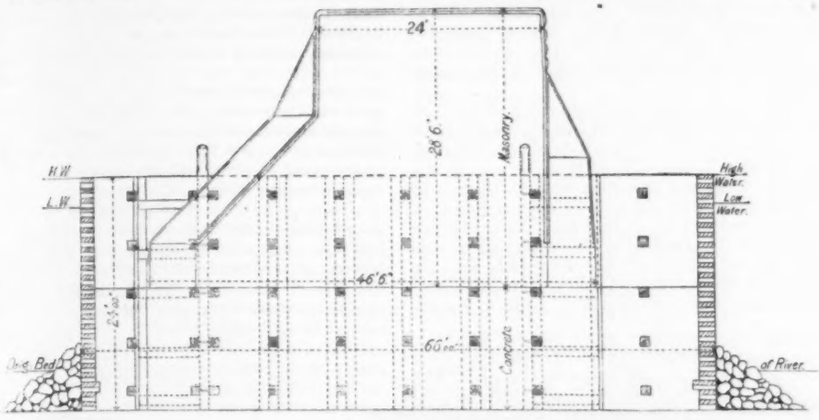
Apparatus for Lowering Caisson, Coteau Bridge.

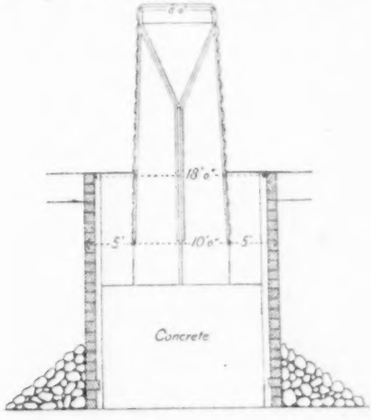
were held together by vertical ties, all of the same dimensions.

The pivot caisson, on account of its construction, presented a tremenduous resistance to the current, four powerful tugs and a large side-wheel steamer being unable to hold it in the swift water. Eight heavy anchors, with good scope of chain, held the caisson about 100 ft. above the bridge line; these were slacked away and the caisson dropped into position. Two (1¼ in.) steel wire cables to anchors were led to blocks made fast near the bottom of the caisson and taken to timber-heads on deck, in order to hold the caisson in an upright position and prevent its being carried out of plumb by the stiff current.

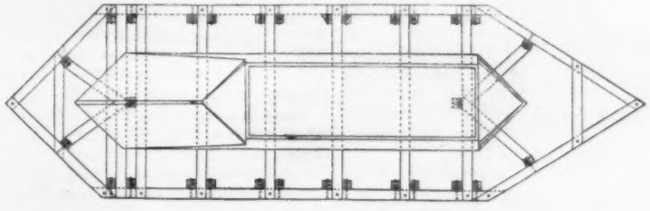
The first caisson was lowered with hydraulic jacks, but this method was found to be extremely

tedious and was abandoned for the block-and-tackle contrivance in sketch shown herewith. Four tackles of large four-fold blocks, reeved with 6-in. circumference manilla rope, guided by lead blocks to winches on board the barges were used to lift the caissons. This plan was very successful and saved much time and labor, reduced the load upon the barges which the other method entailed, and decreased the danger to workmen to an insignificant degree. When the caisson was in position, all that was necessary to sink it was to ease away on the tackles simultaneously, and keep enough weight on the caisson to overcome the buoyancy. Should it not set in true position the first time, some of the ballast was removed and a strain taken upon the tackles, when it could be raised without difficulty; this might be repeated as often as necessary, but it only occurred once or twice that a caisson had to be lifted after once having been placed upon the bottom.





Sectional Elevation of Caisson and Pier; Coteau Bridge.



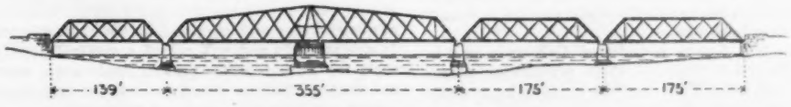
Plan of Pier and Caisson.

The caisson being settled in true position, was heavily weighted with railway iron, and usually the footing course of masonry was likewise placed upon the shell of the caisson. The barges upon which the caisson was transported were then removed, and the concrete gangs set to work. Divers were sent down to examine the bottom and to "bag" the caisson. The canvas curtain, 6 ft. wide, which had previously been nailed on the inside of the caisson 2 ft. from the bottom, was unrolled and laid on the bottom of the river, and upon this were piled bags of concrete to prevent any wash to the concrete afterwards to be deposited. Once commenced, the concreting was carried on continuously, day and night, until the caisson was finished. A floating electric light plant furnished the light for the night gangs. A derrick scow and a transport barge were placed alongside the caisson, and, as the concrete was mixed, it was deposited in covered boxes, holding 1 cu. yd., to prevent the separation of the materials which would ensue from allowing the concrete to fall unprotected through the water.

The composition of the concrete was one part English Portland cement, one part sand, and five parts broken stone of 2-in. cube. A depth of concrete equal to half the depth of the water was deposited in every caisson. After allowing the concrete 48 hours for setting, the caisson was pumped out with an 8-inch horizontal centrifugal pump, driven by a 30 h. p. engine, both on a scow alongside and connected with the caisson by a rubber suction hose, to allow for the oscillation, which would be destructive to a rigid pipe. The pumping of a caisson usually took from 20 minutes to half-an-hour, and when this was accomplished the masonry was commenced on the bed of concrete and carried on to completion.

The pivot pier differs from the others in being a cylindrical column 27 ft. in diameter, with two footing courses extending to 29 ft. 6 ins. Iron sheathing on the cutwaters protects the piers from the heavy flow of ice, which runs before the lake "takes," and after it breaks up again in the spring. The stone used for the piers and abutments is Trenton limestone, taken from the quarries at Apple Hill, on the Smith's Falls extension of the C. P. Ry., and is of a very rich color, giving the work an appearance of massiveness beyond that of gray limestone. The last stone was laid on December 6, and, in the masonry and concrete, 20,000 barrels of English Portland cement were employed.

The superstructure is unlike that of its neighbor, the C. P. Ry. bridge at Lachine, the Lachine bridge being a pin connection, while the Coteau bridge is of the double triangular riveted lattice design, and the comparative merits of both structures, in a climate of almost unlimited fluctuation of temperature, may be watched with interest. In the north channel the first span is 139 ft.; next to this is the swing of 355 ft., and two other spans of 175 ft. each cover the channel from the north shore to Giroux Island, which is crossed by an embankment 20 ft. high and 900 ft. long; Isle-aux-Seines is crossed by a similar embankment 1,100 ft. long. The middle channel is covered by 10 spans of 217 ft. each, and the south channel by four spans of 223 ft. each. With the exception of the rivets, the entire superstructure is of steel.



Coteau Bridge; Pivot Span, Etc.

The method of placing the spans was not dissimilar to that of transporting the caissons; they were erected at Clark's Island and floated into position, supported on two scows. By means of valves the scows were depressed sufficiently deep to allow the ends of the floor beams to rest upon the bridge seats, when the scows were removed. The plan was very economical and remarkably successful. A feature worthy of note in this important enterprise was the absence of accidents to workmen; in connection with the substructure not an accident of the least significance occurred.

The extreme length of the bridge, including islands which are trestled, is 6,035 ft., or about 1⅛ miles. The line over the bridge is a dead level and a perfect tangent. The average depth of water is 34 ft., and the elevation of bridge seats is 17 ft. 6 ins. above mean water level. The bridge is for a single line of rails.

The Chief Engineer of the bridge was Mr. GEORGE A. MOUNTAIN, C. E., with Mr. G. R. L. FELLOWS as First Assistant. The substructure was erected by Messrs. Neelon, McMahon & Shea, of St. Catharines, Ontario; and to Mr. W. M. SHEA, of this firm, we are mainly indebted for this excellent description of the methods employed in putting in the foundations. The Dominion Bridge Co., of Lachine, Quebec, were the contractors for the superstructure.

It might be added that the trusses were erected on the edge of the south shore in 6 ft. of water and on falseworks of the same elevation as the bridge. Two scows, built for this purpose and 90 ft. long by 40 ft. wide, were provided with four large trestle bents on each; these scows were lashed together with a space of 70 ft. between them. By means of valves water could be admitted into the hulls of the barges so as to sink them about 2 ft. When these scows were immediately underneath the span, the water was siphoned out and the barges and trestles rose and lifted the span off of its falseworks. The scows and span were then towed to the bridge site; placed in position between the piers, and by sinking the scows again the span was lowered to its permanent seat on the piers.

The substructure was commenced on April 1, 1889, and completed on Dec. 1, 1889. The quantities in the substructure were 8,000 cu. yds. of masonry and 7,000 cu. yds. of concrete. The erection of the superstructure was commenced on Sept. 1, 1889, and completed on Feb. 15, 1890. We are indebted to Mr. GEORGE A. MOUNTAIN, Chief Engineer, for the points given in the latter part of this description.

The Nochistongo Cut, and the Drainage of the Valley of Mexico.

In last week's issue a description was given of the great drainage work now being carried on in the Valley of Mexico; and the great cut of Nochistongo, one of the most interesting examples of ancient engineering practice in existence, was illustrated. For the photograph from which our engraving was reproduced we are indebted to Mr. ROBERTO GAYOL, C. E., one of the engineers of the Drainage Commission.

To understand why this great excavation was made it is necessary to give some further details of the drainage conditions. The Valley of Mexico is

an immense basin completely bounded by high mountains, with only two or three passes out of it, and those high. No water drains out of the basin. The surface of this valley has a mean altitude above the sea of 7,413 ft. and an area of about 2,200 sq. miles. In this valley are six great lakes, of the following dimensions:

Name.	Mean length.	Mean width.	Mean depth.	Area.
Chalco.....	9 miles	9 miles	5 ft.	81.59 miles
Xochimilco.....	6.5 "	3.56 "	5 "	23.14 "
Texcoco.....	13.60 "	7.50 "	3 "	102. "
Xaltocan.....	7.44 "	3.72 "	2.3 "	27.67 "
San Cristobel...	4.34 "	1.24 "	2.3 "	5.38 "
Zumpango.....	3.10 "	2.17 "	4.1 "	6.73 "

Each of these lakes is fed by streams of little volume during the dry season; but when the rainy season sets in they swell to considerable size and at times overflow the valleys. The lake of Zumpango was the most dangerous of these, for it received the waters of the Cuautitlan River, a river draining a large area of country. It is this river that has been turned into the cut of Nochistongo, and it has ceased to trouble Mexico and its environs with its overflow.

At the present time Lake Texcoco more than any other menaces the security of the capital. By reason of the unwise cutting down of the forests, since the Spanish conquest, the waters pouring down into the valley from the surrounding mountains bring with them annually great quantities of alluvial matter, which fills up the lake bottom and have so raised the normal water level that inundations are of frequent occurrence. The general level of the City of Mexico is only 6.56 ft. above the surface of the lake, and the bottom of this lake is raised by the deposited silt about 1½ ins. per annum. The water of this lake, and of the three smaller lakes to the north of it, is salt; more so than the waters of the Baltic sea, but less than that of the ocean. It disengages sulphureted hydrogen in abundance. The lakes Xochimilco and Chalco contain fresh water, kept so by the snow falling on the neighboring mountains.

Observations taken during many years at the observatory in Mexico show that the average annua rainfall in the center of the valley is 24.8 ins. Based on this average the entire valley would receive per year about 151,317 million cu. ft. of water upon its surface. One-third of this volume is drained into the Cuautitlan and passes through the great Nochistongo cut, illustrated last week. About 70,600,000 cu. ft. are evaporated or used in agriculture, and the six lakes receive the rest. But owing to their shallowness and great surface the evaporation is estimated as ranging between 0.12 in. and 0.2 in. per day, so that the volume evaporated is almost equal to the average daily rainfall. The rainy season lasts five months, from June to October. During this period five times as much water falls as during the rest of the year, and as the evaporation diminishes and can no longer compensate for the rainfall the valley is more or less flooded.

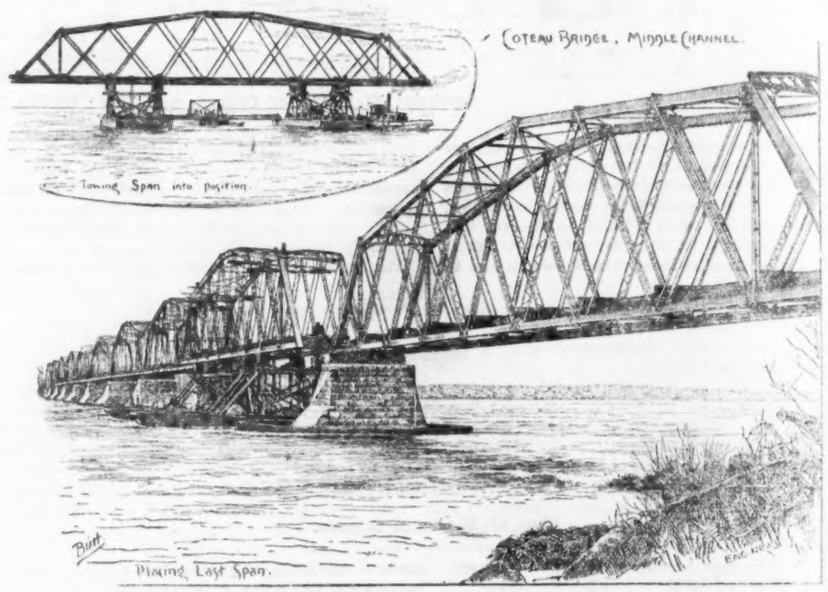
The Valley of Mexico is generally porphyritic in its formation; but, in the south principally, trachite and basalt occur, and igneous phenomena of recent period show themselves in vast beds of lava and volcanic sand. The bed of the valley is made up of lacustrian deposits and beds of transported materials of variable thickness.

When the Aztecs abandoned California, and by little groups commenced their mysterious march toward the south, they discovered the valley to which they later gave the name of Mexico. The waters then formed two immense lakes extending north and south, with some islands emerging from their surface. The Aztecs here founded their capital according to the Indian tradition, when the imperial eagle, which served as their guide, perched upon a rock and destroyed a serpent, in accordance with the prediction of their oracles. The exact spot where the eagle landed is marked by a monument and public square. After gradually making themselves masters of the surrounding nations, the Mexicans commenced to battle with the waters about them, and in 1450 MOCTEZUMA constructed a vast dike near his capital. It was made of massive masonry and clay and was crowned by a stone wall about 10 miles long. This dike divided the great lake into two parts, the greatest, to the east, was called Texcoco, from the city on its bank, and the one to the west was called the Lake of Mexico, and surrounded the Aztec capital. Other public works of a like nature, but the recital of which not essential to this sketch, were performed by MOCTEZUMA and his wise uncle, NETZAHUALCOYTL.

In 1519 CORTEZ arrived in the Valley of Mexico, put a squadron afloat on Lake Texcoco, and ordered the destruction of the great dike so that he could besiege with his fleet the Mexican capital. The conquerors paid little attention to preserving or extending the protective works of the Aztecs, until after several destructive floods the Viceroy, LUIS DE VELASCO, in 1607, by the wise counsel of ENRICO MARTINEZ, undertook to drain the valley. The plan was to turn the waters of the Cuautitlan River, by means of a tunnel, into the Gulf of Mexico by way of the rivers Tula and Panuco. At this time the Cuautitlan was the sole cause of the inundations.

Work on the tunnel was commenced on Nov. 28, 1607, under the direction of ENRICO MARTINEZ, and it was completed in 11 months, a seemingly impossible feat when it is remembered that the tunnel was 21,648 ft. long, and in section was 11.5 ft. wide by 13.77 ft. high. They also dug an open trench 28,200 ft. long to connect the tunnel with the Tula River, and also two long and deep canals serving as conduits for the waters of Lake Zumpango and the Cuautitlan River. Unhappily, for economical reasons and to gain time, the Spaniards failed to line the excavation; and as a consequence the water cut away the sides to such an extent that in 1609 the tunnel was blocked and useless. The material penetrated was *tepetate*, a material somewhat resembling sun-baked clay and supposed to be volcanic mud. It works easily and will retain a vertical slope like rock for an indefinite period, and even undercut without falling. Vast areas of Mexico, including the Valley of Mexico, are underlaid with it to a great depth.

In 1614 a Dutch engineer named ADRIAN BOOT was sent out to report on the work. He condemned MARTINEZ' plans and pronounced the tunnel useless. He proposed new works, to cost $185,900. MARTINEZ offered to complete his work with 300 men and $100,000, and his offer was accepted, but for lack of furnishing a bond, which he had offered to give, he was thrown into prison but finally released. Some years passed without anything further being done to remedy this state of affairs,* and in 1629 a terrible flood occurred which in one month cost the lives of 30,000 people; 20,000 families were driven away, and scarcely 4,000 remained. The waters did not materially lower until in 1634, when a violent earthquake opened fissures in the soil of the valley. In 1637 (the truly great and able MARTINEZ having died some years before), the viceroy CADEREYTA decided, without reflection, or rather because it was a plan requiring no other material than human muscle, which he did not pay for, that he would convert the tunnel of MARTINEZ into an open cut. This enormous undertaking was commenced in 1640 under the direction of Father LUIS FLORES, of the Franciscan order, and was finished in 1789. The cut was 12.4 miles long, with a maximum width of 361 ft. and a greatest depth of 197 ft. The cube was no less than 70,721,526 cu. Varos, or about 54,100,000 cu. yds. The work was performed by natives, gathered by force from their villages and confined in pens near the scene of their labor, and driven in their work by the most cruel taskmasters in the world—the Spaniards. A side tunnel was found, when the Mexican Central Ry. was building its track through this cut, which had been driven to connect the bottom of the cut with the slave pens, and by this tunnel only were the laborers permitted to pass to and from their work. The loss of human life during the 150 years consumed in excavating this cut can be now only estimated, but it was enormous. It is claimed to have been as high as 80,000.



The Coteau Bridge over the Middle Channel of the St. Lawrence River.
GEORGE A. MOUNTAIN, *Chief Engineer.* The Dominion Bridge Co., *Builders.*

At the present time this great cut, owing to the erosion of water and the slipping of its sides, looks almost as much like a work of nature as like a cut made by human labor. The Mexican Central Ry. passes along its right bank, and it is only by constant watchfulness that danger is avoided. For a long time after the Nochistongo cut was completed no further works were attempted for draining the valley; and in the following years, if danger became too menacing, the people contented themselves with making a few indispensable repairs, or they built works of a temporary character. But the construction of something of more permanent value in draining the valley of Mexico has long been seen to be inevitable, and is now actively under way, as was last week more fully described.

For construction of the canal a tax of 1 per cent. was laid on all buildings in the city, not excepting churches, and the total valuation returned as a consequence of this assessment was $20,267,555, a pretty good valuation for Mexico in 1607.

In the digging of the tunnel which preceded the canal, no less than 471,154 workmen were employed, meals for whom were prepared by 1,674 cooks. This force was employed from Nov. 16, 1607, to May 7, 1608, only, or 5 months, 21 days, the total cost of the work, with all this enormous force, being only $73,611, which shows that the Indians were miser

*It is reported on what seems to be good authority that in the first four months, in 1629, the tunnel had been completely cleaned out, but that the mouth of it was maliciously choked by some one; it was alleged by MARTINEZ himself, harassed by continual attacks on his work, and determined to prove that it was not useless as charged. MARTINEZ was arrested on this charge, proved his innocence, and released on Sept. 21, 1629, with orders to open the mouth of the tunnel, but, unfortunately, on the very next day the waters of the great flood inundated the city six or seven ft. deep.

ably oppressed. Nothing but the very peculiar soil through which the tunnel was driven made such rapid progress possible; but the shafts were sunk very close together (as with many other old Mexican drainage and irrigating tunnels still existing), and the tepetate cuts like earth while holding a slope for a time at least quite as well as rock. None of the engineering difficulties due to earth tunneling were encountered, consequently, although digging could go on as fast as in hard clay, the use of powder was not necessary. It is quite possible that had the tunnel been thinly lined with brick, so as to prevent flaking off merely, it would be in good condition at this day.

According to a report to the viceroy, however, the loss of life in building this tunnel was very small. Out of the whole vast army of laborers only 50 are reported to have died, and 10 of these by an accident. It is quite certain that the natural deaths would have been more than this, so the report is probably wholly untrustworthy.

In part, this tunnel was lined with masonry when constructed, and certain short sections of it still remain in the bottom of the open cut, giving the dimensions of the old work.

The rate of progress in the great work is indicated in a measure by the total of expenditures by decades on it, of which accurate records exist in dollars (*pesos*) *reales* (12½ cents), and *granos* (about a fifth of a *real*, apparently). Omitting the fractions the expenditures per decade were as follows, showing very irregular activity:

1607-17	$891,280
1617-27	573,602
1627-37	1,504,531
1637-47	338,857
1647-57	266,865
1657-67	230,500
1667-77	220,996
1677-87	46,734
1687-97	156,123
	$4,229,582

The force employed on the work was almost inconceivably vast. In 1607-8 reports show that 471,154 day laborers were employed, with 1,164 persons engaged in preparing their food. In 1608-1611 the average force was 128,650, including 3,556 women engaged in preparing their food.

In 1675 the high official in charge of the work claimed that it was completed, and ordered pompous ceremonies; but, as a matter of fact, it was very far from being finished. One of the causes of the depopulation of the valley of Mexico during this period was the terrible hardships endured by the Indians. Whole villages were impressed for the service at times. At other times the villagers worked in turns, a few being left behind to raise crops; but little mercy was shown them, and many perished either from hardship or drowning. Thousands worked at once, suspended by ropes down the steep sides, and, practically, all the material was carried out in baskets on men's heads or in cloth sacks on their backs, methods in use to this day in Mexico.

Against the 6 to 10 months which were employed in digging the first tunnel, 159 years were employed in making the open cut, a contrast somewhat due to difference of administration, but mostly to the vast difference in quantities.

The work will always remain one of the greatest existing monuments of the industry of man, especially when we consider that it was executed by the most primitive methods only, without aid from any kind of engineering plant.

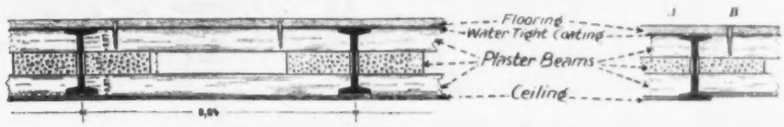
A New Floor Construction.

Herr HAESECKE has described a new method of laying floors, much praised in Germany, in a recent number of the *Centralblatt der Bauverwaltung*.

Iron girders are laid in the usual way. The space between the girders is filled with Mack's "plaster beams," a material that is being extensively used abroad for many purposes. A layer of these timbers, usually 2.5 m. by 20 to 25 cm. wide, is laid along the lower flanges of the girders at right angles to their length. If the ceiling is to cover the bottoms of the iron beams, then the plaster timbers must be cut away at the ends as shown in Fig. 1. The joints are filled with plaster-of-paris. Then on these beams, close to the webs of the girders, another set is placed at right angles to the first, and this process is continued until the upper surface of the joists is level with or slightly overtops the girders. All joints are carefully closed with plaster, as before. The wooden flooring can be nailed to these beams in the same manner as usual. In order to prevent the penetration of moisture into the structure, the last layer of beams should be coated with a water-tight cement. Linoleum or any other suitable material may be used in place of the wooden flooring.

The advantages of this construction are obvious. The plastering of the ceiling can be applied directly to the bottom beams. In order to carry this plastering under the girders the flanges should be covered by wire lathing fastened to the adjacent beams. (It has been found almost impossible to prevent the iron girders from causing cracks in the ceiling, hence it is always best to have the design adapted to the disposition of the girders to which it is attached.) No lathing or covering of any sort is necessary, and the only moisture that can come near the beams is the slight amount applied in the plaster filling used to join the pieces after they are laid in position. The girders are protected on all sides by fireproof substances, and the whole of the floor is admirably adapted to diminish the spread of a fire. It is a much poorer conductor of sound than the wood system, a poorer conductor of heat, a good flooring from a sanitary point of view, and, moreover, very light and cheap.

A comparison of some examples of wooden and plaster floors now in actual use will show the comparative value of the new system as regards the old.



A New Fireproof Floor Construction.

1. Plaster beams between iron girders:

	Kilos.
1 girder	31.2
Plaster beams, 2.48 sq. m. at 45 kilos.	111.6
Ceiling plaster, 1 sq. m.	15.0
Linoleum floor	2.2
Total for each sq. m.	160.0

2. Wooden beams:

	Kilos.
Weight of beams, per sq. m.	47.3
Lathing, plastering, flooring, etc.	198.2
Ceiling plaster, 1 sq. m.	16.0
Linoleum floor	2.0
Total for each sq. m.	263.5

The girders are spaced 84 cm. from center to center. The plaster beams, then, are sawed into three equal lengths. The wooden beams are 26 cm. by 28 cm., and are spaced 1 m. apart, with light battens between them.

The cost of the two systems is as follows:

1. Plaster beams between iron girders:

	Marks.
31.2 kg. girder, at 0.20 marks	6.24
2.48 sq. m. plaster beams, 7 c. m. deep, at 2.75 marks	6.82
Ceiling	0.00
Linoleum and painting	4.14
Total per square meter	17.80

2. Wooden beams:

	Marks.
Beams and laying the same	4.30
Flooring, lathing, etc.	6.70
Ceiling	1.00
Linoleum	3.60
Total	15.60

(1 mark = 25 cents, nearly.)

As some of our readers may not be acquainted with these plaster beams, a few words about them may be of interest.

They are made by placing alternate layers of reeds and plaster made with lime water in a mould something like a picture frame. These masses are then dried as quickly as possible in drying ovens built for the purpose. When dried, they can be cut with a saw like wood and nailed in the same way. The weakest timbers are covered with asphalt cement. The price in Berlin varies with the strength from 1.50 to 2.50 marks per sq. m.. They weigh from 6 to 7 kilos. per sq. m. with 1 c.m. thickness.

The results of experiments on their strength, made in the presence of the government engineers, are as follows:

(*a*). Uniform load, slowly applied.

A beam 2.5 m. by 0.20 m. by 8 c.m., weighing 28.5 kilos., was chosen. These were laid as shown in Fig. 3, and upon them 85 similar pieces were placed, making the total load 2,422 kilos., or 4,250 kilos. per square meter. No effect of any kind could be observed from this loading.

(*b*). Suddenly applied load. A weight of 55 kilos. was dropped from a height of 2 m. on the upper surface of a beam. It made a dent 5 mm. deep in the upper surface and produced a few small cracks in the lower surface of the piece it struck. The remaining beams were not affected. Other experiments showed the same results.

The Electrical Transmission of Power.

A remarkable electrical transmission plant has recently been put down in the State of Nevada, in the world-famous Comstock Lode and the almost equally famous Sutro Tunnel. At the Nevada Mill there is a 10-ft. Pelton water wheel, which receives water through a pipe-line delivering water from the side of Mount Davidson under a head of 460 ft., giving 200 horse power. Here the water is again caught up, delivered into two heavy iron pipes and conducted down the vertical shaft and incline of the Chollar Mine to the Sutro Tunnel level, where it is again delivered to six Pelton water wheels, this time running under a head of 1,080 ft. Each of the six wheels is but 40 in. in diameter, weighing 225 lbs.; but with a jet of water less than ⅝ in. in diameter, they develop 125 horse power each. On the same shafts, which revolve 900 times a minute, are coupled six Brush dynamos, which generate the current for the electric motors that drive the stamps in the mill above ground. The result is, that where it formerly took 312 miners' ins. of water to operate 35 stamps, but 72 ins. are now required to run 60 stamps. This is the greatest head of water ever used by any wheel, and by itself constitutes an era in hydraulic engineering. A solid bar of iron thrown forcibly against this tremendous jet rebounds as though it had struck against a solid body instead of a mobile fluid. The speed of this jet, where it impinges against the buckets of the wheel, is two miles a minute—176 ft. a second. The wheels only weigh 1.8 lbs. per electric horse power when working with the maximum head, figures which are only surpassed by the Brotherhood engines used for driving torpedoes, and possibly by the Parsons steam turbine. At the Terni steel works in Italy there is a Girard turbine using water under a head of 1,000 ft., which we believe is the greatest head used in Europe.—*Exchange.*

The Extraction of Oxygen from the Atmosphere.

[FROM A LONDON CORRESPONDENT.]

Oxygen is a substance which we could not get on very well without, and yet, for which, up to now, we have found comparatively few applications; that is to say, nature uses it more than man. Some time ago, when the writer first had the question of producing oxygen on a commercial scale brought before him, and was waxing eloquent to a matter-of-fact friend on the great future before the Brin Co., which had been just started to produce it, he was stuck by the remark: "Well, what are you going to use the oxygen for when you have got it?"

That is the question Brin's Oxygen Co., of London have now to answer. Having so far perfected the apparatus by which the oxygen is extracted, they are now busily engaged in the ultimate business of all civilization; namely, creating a want. They have so far succeeded that gas makers, bleachers, some iron workers, whiskey drinkers and other industrials find it difficult to get on without oxygen; indeed, oxygen, instead of being simply the product of the laboratory, has become a commercial article of no inconsiderable importance.

All this has taken place within the last year or so, and has been the result of the labors of two French chemists, the brothers Brin, and those who have since taken up the business. The writer has had

opportunities of becoming acquainted with the method of operation pursued in extracting oxygen from the atmosphere at the works of the Brins Oxygen Co., in the Horseferry Road, Westminster, and it seems to him that the growing importance of oxygen, as a factor of industrial economy, is sufficient to justify a brief description of the system.*

About thirty years ago the French chemist BOUSSINGAULT discovered that the monoxide of barium would absorb oxygen from the atmosphere, if heated to a temperature of about 1,000 degs. Fahr., thus forming a dioxide of the metal. If further heated to a temperature of about 1,700 degs. Fahr. the dioxide would give off a part of its oxygen, which could thus be gathered and stored for use, while the monoxide of barium would remain. At first it was hoped that this process could be carried on indefinitely, but it was soon found that the barium oxide gradually lost its power after the process had been gone through a certain number of times. The invention, therefore, remained for many years of scientific rather than of commercial interest, and it is only just now that the process has been developed into one of industrial importance.

The way in which this has been brought about has been chiefly by preparing the oxide of barium in a more careful manner, so that it will last for a very long time; by using vertical steel retorts; by the application of certain automatic actions to the machinery and, above all, by the substitution of varying pressures for varying temperatures. We will, without further preface, proceed to describe the apparatus by which the process is carried on. Figs. 1 and 2 on pages show respectively a sectional elevation and a plan of the whole apraratus; Fig. 3 is cross section through the gas producer and combustion chamber. In Figs. 1 and 3 *A* is the generator where the carbonic oxide (which is the gas used for fuel to produce the heat required) is generated. *B* is the combustion chamber where the carbonic oxide is burnt. The retorts containing the barium oxide are shown at *C* in Fig. 1. We will, however, leave the heat generating apparatus for the present and proceed to describe the process.

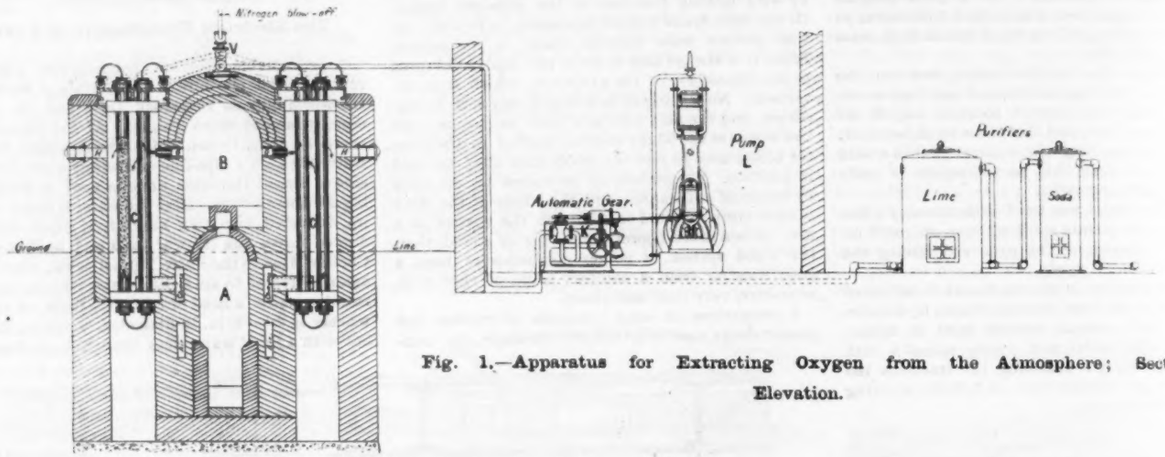


Fig. 1.—Apparatus for Extracting Oxygen from the Atmosphere; Sectional Elevation.

Air is drawn in at the intake *o*, Fig. 2, by means of the air pump shown. It passes to the valve *M*, Fig. 2, and is then compressed to about 10 lbs. to the square inch. After that is delivered through the valve *N* and pipe *p* to the purifiers. These consist of two cylindrical steel vessels and two cast-iron vessels as shown. The first are half filled with quick lime, CaO, whilst the second are charged with caustic soda, NaOH. The air passes through one, or both of the lime chambers, and through only one of the soda chambers. The object of these purifiers is to free the air from moisture and carbonic acid. In this country one ton of quick lime is generally about sufficient to purify three millions cubic feet of air. The lime, however, is never completely slaked, as if it were it would offer great resistance to the passage of air. The part of the caustic soda is to finish more completely the drying of the quick lime and the extraction of carbonic acid. From the purifiers the air passes through the pipe *e* to the automatic gear, the use of which will be more fully explained presently. Part of this gear consists of the two-way cock *O* which leads into the pipe *b*, and thence into the automatic valve *k*, shown in Figs. 2 and 3. It will be seen, by reference to the latter, that the lower part of this valve consists of a flat chamber divided into two parts by a horizontal diaphragm. This diaphragm is connected to the two valves, seen above it, by means of a spindle. When the air, at the pressure of 10 lbs. to the square inch, passes into the valve it presses on the diaphragm and forces the latter down. This has the effect of closing the lower of the two valves and opening the upper one. The use of the latter will be explained when we deal with the second half of the cycle of working. The bottom valve being closed the air is made to pass through the distributing box *l* to the pipe *n*, see Fig. 2, and in this way it is conveyed into the retorts, which are shown in Figs. 1 and 2, and which are subject to the heat of the burning carbonic oxide. In the retorts the baryta, or barium oxide, absorbs the oxygen, while the nitrogen passes up through the pipe *o*, Fig. 2, through a second passage in the distributing box *l*, then through the upper of the two valves attached to the diaphragm spindle, and thus through a weighted valve *s* to the atmosphere. It is by means of this relief valve *s* that the pressure in the retorts is controlled.

So far we have got the oxygen from the atmosphere with the baryta, which is in the retorts. It now remains to get the oxygen from the baryta with the storage receptacle.

In order to do this the suction of the air pump has to be reversed (that is, the delivery branch *b* is converted into a suction branch, as the pumps always run one way) so that the retorts are subject to a vacuum instead of the pressure of 10 lbs. to the square inch. The reversal is effected by the automatic gear, before referred to, in the following manner: attracted to the steam cylinder *R*, shown in Fig. 2, there is a cam, shown in Fig. 1, which is actuated by suitable mechanism so that at a given time (the peroxydation of the baryta takes about 7½ minutes) it opens a retention valve on the cylinder, and steam is thus admitted to the latter. In this way the cocks *M*, *N* and *O* are reversed. By this action the purifiers are cut off under pressure, and are thrown out of the system for a time. The suction cock *M*, through which the air was formerly drawn into the pump, is now thrown into communication with the retorts, and the delivery cock *N*, through which the air was formerly

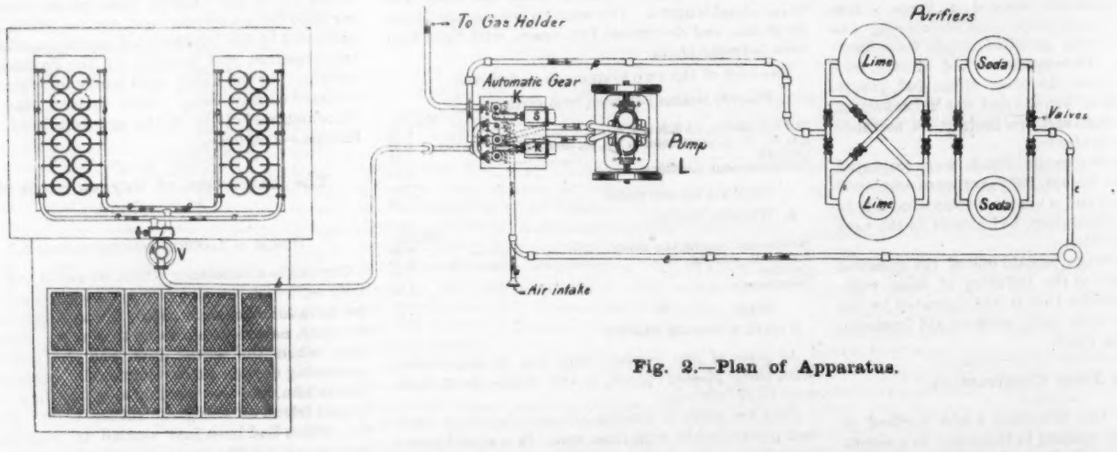


Fig. 2.—Plan of Apparatus.

* Fuller particulars of the method of manufacture and uses of oxygen will be found in the transactions of the following English societies: Paper by Mr K. S. MURRAY on "The Mechanical Appliances Employed in the Manufacture and Storage of Oxygen," read Jan. 31 last before the Institution of Mechanical Engineers; paper read before the Society of Chemical Industry on Feb. 28, 1889, by Dr. L. T. THORNE on "Some Industrial Applications of Oxygen," and a paper by Mr. W. A. VALON, Gas and Water Engineer to the Ramsgate Corporation, "On the Manufacture of Oxygen on Gas Works, and the Result of its Practical Application to the Purification of Coal Gas," read before the Gas Institute on June 19, 1889.

delivered into the purifiers, is put in communication with the cock *P*, which is on the pipe leading to the gas holder, where the gas is stored. The automatic apparatus having established the connection last described, the pumps take their suction from the retorts, and the vacuum necessary for the process is therefore created. This vacuum acts on the diaphragm in the valve *K*, and in this way the uppermost of the two valves on the diaphragm spindle is closed and the bottom one is opened, the action naturally being the reverse of that which took place when the pumps were putting a pressure of the diaphragm. By the reversing of the two valves in *k* the connection with the atmosphere through which the nitrogen escaped is cut off, and a communication is opened between the top and bottom of the retorts, which enables the vacuum to be more readily created. Pure oxygen is not extracted from baryta until a vacuum of 26 ins. is reached. When the deoxidation of the baryta is complete the automatic gear reverses the cocks, pressure is again set up in the retorts, and the baryta again absorbs oxygen.

While this cycle of operations, consisting of a period of pressure and a period of vacuum in the retorts, is being carried on, the retorts are kept at a constant temperature. This is probably about 1,300 to 1,400 degrees Fahr. In the old process where a variation of temperature was used, the retorts and their connections wore out with disastrous rapidity, as any engineer will understand. The greater durability of the plant, due to the constant temperature, is the great reason of the lesser cost of production.

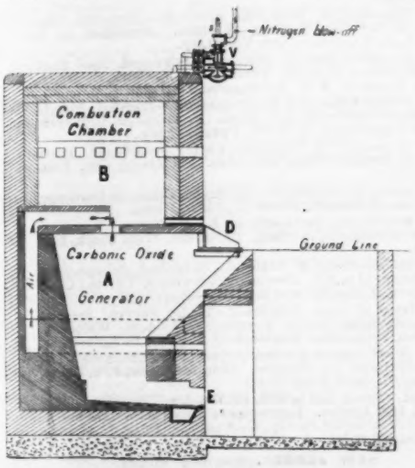


Fig. 3.—Cross Section through Gas Producer and Combustion Chamber.

In order to explain our illustrations more fully it is necessary to make further reference to the heat-producing part of the apparatus, although those at all acquainted with the construction of gas producers will understand the arrangement at a glance. Referring to Fig. 3, coke is charged into the carbonic oxide generator *A* through the door *D*, *E* being a clinker door. There are no fixed fire bars, but a jet of steam is used to prevent clinker on the walls. The limited quantity of air for the primary partial combustion of the fuel is admitted through small portholes on each side of the clinker door. The carbonic oxide passes up through the opening shown between the chambers *A* and *B* into the latter. Here it meets the further supply of air which converts it into carbonic acid in the ordinary process of combustion. The air necessary for this combustion is taken in through passages formed in the walls of the chamber, as shown in Figs. 2 and 3, and is thus warmed so as to more readily promote combustion. It will be seen that the carbonic oxide and warmed air meet as each emerges from its respective delivery orifice. The hot gases leave the combustion chamber through the openings *G*, Fig. 1, and circulate among the retorts, after which they pass to the chimney.

By the process thus described it is possible under the most favorable circumstances to produce oxygen gas at about 2s. per 1,000 cu. ft., supposing it is used as it is made and does not require compression. When oxygen is produced in special works, however, where the incidental charges have to be debited wholly to the process, the cost rises to 7s. Even this would not include compression into the storage flasks, in which the gas is placed for transfer. Compressing to 120 atmospheres, which is the standard pressure, costs about 2s. and 6d. per 1,000 cu. ft. It may be stated, however, that the whole thing is yet undeveloped, so far as the commercial aspect is concerned; for instance, the more recently established works at Manchester, with their quite new plant, work at a much cheaper rate than the London establishment.

The cheapening of oxygen has led to the discovery of many industrial uses for it; and these appear to to be increasing almost daily. We will refer to one or two of the most important only.

In the manufacture of ordinary illuminating gas oxygen is already playing an important part. It is used for purifying the lime which cleanses the gas of the sulphur compounds. Oxide of iron is now used largely for gas purification. It has been customary to revivify the oxide by means of air. This air was admitted continuously with the gas about to be purified. The oxygen carrying on the regenerative process was thus absorbed, while the nitrogen passed over with the purified gas, the illuminating effect of which was reduced by the inert properties of the nitrogen. The substitution of oxygen for air, effected, as might have been expected, a marked improvement, but it was further discovered that the oxygen had so beneficial an effect on the lime itself, that the auxiliary oxide purifiers could be advantageously abandoned. The whole process of gas purification is thus improved; and not only that, the illuminating power of the gas is increased if a small portion of free oxygen be allowed to pass over with the gas. Perhaps, however, one of the most striking advantages of this process is that, in place of the foul-smelling spent lime, so familiar in the nostrils of dwellers near gas works, the final result is an inodorous compound. The chief installation of this system has been made at the Corporation gas works at Ramsgate in Kent, by Mr. VALON, who has worked out many important features of the system.

In bleaching, oxygen has been used with advantage; but what has been done is nothing to that which will follow if what is foreshadowed by the researches of Dr. THORNE, chemist to the Brin Company, come to pass. It would carry us too far into the domain of the chemist to give even an outline of the principles involved in this subject; so far it has been discovered that free oxygen may be made a most valuable adjunct in bleaching process. It cannot, however, be used alone, but has to be combined with bleaching powder. It is supposed by Dr. THORNE that the nascent oxygen of the chlorine has the power of starting the bleaching process, which the free oxygen can then carry on.

In the preparation of drying-oils oxygen will no doubt play a large part in the future, for the results are so far very promising. In varnish making, the manufacture of floor cloths and other industries, many of which are kept secret, it is already of considerable importance.

The use of oxygen which appeared to afford the most lively satisfaction to the meeting of the Mechanical Engineers was that which was described by one of the most popular and portly members of council. In jovial tones he told how he had laid down a quantity of whisky to mature. Instead of having to wait five years for it to come to perfection, he found that by use of oxygen he could drink it at once. It appears that the decomposition fusil oil, which is the great noxious element in spirits, is effected in a few days by oxygen, in the place of the years necessary if the ordinary course be pursued.

New German Pavements.

A recent number of the *Zeitschrift für Transportwesen* describes two new German pavements. In the first, a concrete bed, 4 to 6 ins. thick, is first prepared. Over this a mixture of asphalt and powdered granite is laid to a depth of about one-half an inch, and then broken granite, in 1 to 2 in. cubes, is placed on this layer, the joints being filled with the same compound. The system is now being tried in Strasburg.

The second novelty is a method of laying wooden pavements. It consists of uniting from 20 to 30 ordinary blocks into a large rectangle by means of galvanized iron wires run through holes bored in the blocks. These large compound blocks can be easily laid by unskilled laborers, and much time saved.

Statistics of Railway Construction.

STATES EAST OF CHICAGO.

(Accompanying Map No. 24 of the Progress and Prospects of Construction.)

CANADA.—Existing Roads.

Baie des Chaleurs.—Partly graded, Cascapedia to Paspebiac, 40 miles. Projected, Paspebiac to Gaspé, P.Q., 80 miles.

1. ***Brantford, Waterloo & Lake Erie.***—Track laid in 1889, Brantford to Waterford, Ont., 17 miles.

2. ***Brockville, Westport & Sault Ste. Marie.***—Track laid in 1889, Lyn to Brockville, 5 miles. Surveyed, Westport to Palmer Rapids, 80 miles.

3. ***Canadian Pacific.***—Track laid in 1889, London to Windsor, Ont., 112 miles. Surveyed, Harvey to Salisbury, N. B., 113 miles. Projected, Toronto to Woodstock, Ont., 99 miles; Hamilton to Niagara Falls, Ont., 40 miles.

4. ***Central Ontario.***—Projected, Coehill to Sudbury, Ont., 210 miles.

Central Railway of New Brunswick.—Track laid in 1889, Norton to Chipman, N. B., 44 miles. Surveyed, Norton to St. John, N. B., 35 miles; main line to Fredericton, N. B., 40 miles; Doaktown to Chipman, N. B., 30 miles.

Cumberland Railway & Coal Co.—Track laid in 1889, end of track to Oxford, N. S., 14 miles.

Drummond County.—Track laid in 1889, Mitchell to Nicolet, P. Q., 23 miles.

5. ***Grand Trunk.***—Track laid in 1889, Peterborough to Chemung, Ont., 9 miles. Surveyed, Edmundston to Perry's Mills, N. B., 180 miles. Projected, Waterloo to Elmira, Ont., 10 miles; Haliburton to Mattawa, Ont., 110 miles.

Great Eastern.—Track laid in 1889, St. Gregoire to Nicolet, P. Q., 7 miles. Projected, Nicolet to Levis, P. Q., 63 miles.

Great Northern.—Track laid in 1889, New Glasgow, P. Q., north, 10 miles. Under construction, Ste. Julienne to Montcalm, P. Q., 8 miles; St. Andrews to La Chute, P. Q., 8 miles. Projected, Montcalm to St. Felix de Valois, P. Q., 15 miles.

6. ***Hereford.***—Track laid in 1889, Cookshire to Dudswell Junction, P. Q., 13.5 miles. Surveyed, Stewartstown to Ayers Flat, P. Q., 12 miles.

Intercolonial.—Track laid in 1889, Oxford to River John, N. S., 47 miles; Pigwash Junction to Pigwash, 5 miles; Port Hawkesbury to Sydney, 98 miles. Under survey, North Sydney to Louisburg, 25 miles.

7. ***Kingston & Pembroke.***—Projected, Sharbot Lake to Appleton, Ont., 45 miles; Renfrew to Portage du Fort, 12 miles; Renfrew to Eganville, Ont., 23 miles.

8. ***Lake Erie, Essex & Detroit River.***—Track laid in 1889, Sand Pit to Leamington, 2 miles.

Lake Temiscamingue.—Track laid in 1889, Gordon to Kippewa, 9.2 miles. Under construction, Long Sault to Mattawa, 35 miles. Superintendent, Emmanuel Tasse, Ottawa, Ont.

Lower Laurentian.—Under construction, end of track east, 20 miles. Surveyed, end of grade to Riviere a Pierre, 30 miles. Contractor, C. A. Scott, Quebec, P. Q.

9. ***Montreal & Ottawa.***—Track laid in 1889, Vaudreuil to Hudson, 8.5 miles. Track laid in 1890, Hudson to Rigaud, Ont., 8 miles. Under survey, Rigaud to Ottawa, 60.5 miles. Chief Engineer, J. M. Shanley, Hudson, Ont.

Montreal & Western.—Under construction, St. Jerome to Shawbridge, 10 miles. Projected, Shawbridge to Chute aux Iroquois, 60 miles. Chief Engineer, G. H. Gordon, St. Jerome, P. Q.

10. ***Napanee, Tamworth & Quebec.***—Track laid in 1889, Tamworth to Tweed, Ont., 20 miles; Harrowsmith to Yarker, Ont., 7 miles. Projected, Harrowsmith to Sydenham, Ont., 10 miles.

New Brunswick & Prince Edward Island.—Surveyed, Sackville to Werd Point, Prince Edward Island, 5 miles.

Newfoundland.—Surveyed, St. Johns to Hall's Bay, Newfoundland, 250 miles.

11. ***Niagara Central.***—Surveyed, St. Catharine's to Toronto, Ont., 70 miles.

Nova Scotia Central.—Track laid in 1889, end of track to Lunenburg, 39 miles. Projected, Middleton to Margarettville, N. S., 8.5 miles.

Nova Scotia Midland.—Under construction, New Glasgow to Whitehaven, N. S., 60 miles. Chief Engineer, G. Rodman Price, Springfield, N. S.

12. ***Ottawa & Gatineau Valley.***—Under constuction, Ottawa to Karyaburyua, 50 miles. Chief Engineer, W. D. Harris, 14 Metcalf street, Ottawa, Ont.

13. ***Pontiac Pacific Junction.***—Projected, Black River to Pembroke, 14 miles.

Quebec Central.—Projected, St. Francis, P. Q., to Maine State line, 46 miles.

Salisbury & Harvey.—Surveyed, Harvey to Alma, N. B., 12 miles. General Manager, Charles R. Scoles, Hillsboro, N. B.

Stewiacke Valley & Lansdown.—Under construction, Brookfield to Lansdown, 37 miles. Surveyed, Lansdown to Newport Station, N. S., 13 miles. Chief Engineer, Lionel H. Buck, Upper Stewiacke, N. S.

Tobique Valley.—Track laid in 1889. Perth Station to Poquoque, N. S., 5 miles. Track laid in 1890, end track towards Plaster Rock, 2 miles. Graded, end of track, towards Plaster Rock, 10 miles. Surveyed, end of grade to Plaster Rock, 14 miles.

14. ***Toronto, Hamilton & Buffalo.***—Located, Welland Junction to Toronto, 80 miles; Hamilton to Brantford, 25 miles.

Western Counties.—Under construction, Digby to Annapolis, N. S., 20 miles.

Projects and Surveys.

15. ***Amherstburg, Lake Shore & Blenheim.***—Projected, Amherstburg to Blenheim, Ont., 60 miles. Vice President, Simon Fraser, Malden, Ont.; Secretary, John Aid, Amherstburg, Ont.

16. ***Aylmer & Port Burwell.***—Projected, Aylmer to Port Burwell, Ont., 15 miles. Secretary, T. J. Winslow, Aylmer, Ont.

Hants Central.—Surveyed, Windsor to Truro, N. S., 50 miles.

17. ***Irondale, Bancroft & Ottawa.***—Surveyed, Bancroft to Irondale, Ont., 40 mile. Projected, Bancroft to

Ottawa, Ont., 110 miles. Vice-President, Chas. J. Pusey, Irondale, Ont. Chief Engineer, G. W. Ranney.

18. ***Kingston, Smith's Falls & Ottawa.***—Projected, Kingston to Ottawa, Ont., 100 miles. D. A. Givens, Kingston, Ont.

Moncton & Prince Edward Island.—Projected. Buctouche to Richbucto, Prince Edward Island, 20 miles.

Nipissing & James Bay.—Projected, North Bay to James Bay, 350 miles. M. J. Butler, Gananoque, P. Q.

19. ***Ottawa, Morrisburg & New York.***—Projected, Ottawa to Morrisburg, Ont., 45 miles. Seller Leishman, Waddington, New York.

St. John Valley.—Projected, Gagetown to Welsford, N. B., 25 miles.

Sault Ste. Marie & Hudson Bay.—Projected, Sault Ste. Marie, Ont., to James Bay, 370 miles. John A. Wilde, Sault Ste. Marie, Ont.

Yarmouth & Lockport.—Under Survey, Yarmouth to Lockport, N. S., 80 miles.

Total.—Track laid in 1889, 495.2 miles. Track laid since Jan. 1, 1890, 10 miles. In process of construction, 297 miles. Surveyed or under survey, 1,253.5 miles. Projects of some promise, 1931.5 miles.

MAINE.—Existing Roads.

20. ***Kennebec Central.***—Under construction, Randolph to Togus, 5 miles. Chief engineer, Frederic Danforth, Gardiner.

21. ***Maine Central.***—Track laid in 1889, Dexter to Dover and Foxcroft, 16.53 miles.

Maine Shore Line.—Surveyed, Hancock to Calais, 93 miles; branch to Eastport, 16 miles. President, J. N. Green, Bangor.

22. ***Rumford Falls & Buckfield.***—Surveyed, Gilbertsville to Rumford Falls, 14.4 miles.

Shore Line Railway of Canada.—Projected, Princeton to Mattawamkeag, 55 miles. F. W. Holt, St. Georges, N. B.

23. ***Somerset.***—Track laid in 1889, Embden to Solon, 3.25 miles. Graded, Solon to Bingham, 7.5 miles.

Projects and Surveys.

24. ***Boothbay Harbor.***—Projected, Boothbay Harbor to Newcastle, 12 miles. Chief Engineer, Henry A. Hancox, Hudson, Mass.

25. ***Castine & Bangor.***—Surveyed, Castine to Milo, 76 miles. President, Jas. Adams, Bangor. A. M. Devereaux, Bangor.

26. ***Georges Valley.***—Surveyed, Warren Station to Union Common, 8 miles. Projected, Union Common to Belfast, 20 miles. Chief Engineer, Henry A. Hancox, Hudson, Mass.

Northern Maine.—Surveyed, Presque Isle to Mattawamkeag, 116 miles. President, Geo. P. Westcott, Portland; Chief Engineer, Frederic Danforth, Gardiner.

Penobscot & Arostook.—Projected, Enfield to Canadian Pacific Ry., 8 miles. President, Samuel L. Montague, Great Works; Chief Engineer, Chas. W. Mellen, Oldtown.

27. ***Phillips & Rangeley.***—Located, Phillips to Rangeley, 27 miles. President, H. P. Clossen, Gardiner; Secretary, H. E. Timberlake, Phillips.

28. ***Rockland, Rockport & Camden.***—Surveyed, Rockport to Camden, 8.5 miles. President, W. T. Cobb, Rockland.

29. ***Waldo & Somerset.***—Surveyed, Burnham Junction to Canaan, 8 miles. President, V. R. Tuttle, Canaan; Chief Engineer, Henry A. Hancox, Hudson, Mass.

Total.—Track laid in 1889, 19.78 miles. In process of construction, 12.3 miles. Surveyed or under survey, 366.9 miles. Projects of some promise, 95 miles.

NEW HAMPSHIRE.—Existing Roads.

30. ***Concord.***—Track laid in 1889, Alton Bay to Lake Villiage, 17 miles; Tilton to Belmont, 4.15 miles; Pittsfield to Barnstead, 4.5 miles. Surveyed, Barnstead to Gilmanton, 6.5 miles.

31. ***Concord & Montreal.***—Franklin & Tilton R. R. Surveyed, Franklin to Tilton, 4.5 miles. President, Chas. Tilton; Superintendent, Geo. E. Todd, Concord; Treasurer, Edgar H. Woodman, Concord.

21. ***Maine Central.***—Track laid in 1889, Fabyan's to Scotts, 17.7 miles.

32. ***Upper Coos.***—Under survey, North Stratford, Vt., to Whitefield, N. H., 30 miles.

33. ***Whitefield & Jefferson.***—Projected, Jefferson to Errol, 50 miles.

34. ***Zealand Valley.***—Track laid in 1889, end of 1888 track to Thompson's Falls, 2.5 miles.

Projects and Surveys.

35. ***Moosilauke.***—Surveyed, Warren to the summit of Mount Moosilauke, 95 miles. President, John H. Pearson, Concord; B. F. Brown, Franklin; John E. Thayer, Woodstock.

Total.—Track laid in 1889, 45.33 miles. Surveyed or under survey, 27 miles. Projects of some promise, 59.5 miles.

VERMONT.—Existing Roads.

36. ***Central Vermont.***—Surveyed, Waterbury to Stowe, 10 miles; Windsor to Bellows Falls, 25 miles.

37. ***Clarendon & Pittsfield.***—Surveyed, Proctor to Brandon, 13 miles. Projected, West Rutland to Tinmouth, 10 miles.

Projects and Surveys.

38. ***Rutland & Woodstock.***—Projected, Rutland to Woodstock, 20 miles. Secretary, L. G. Kingsley, Rutland.

Total.—Surveyed or under survey, 87 miles. Projects of some promise, 30 miles.

MASSACHUSETTS.—Existing Roads.

39. ***Boston & Maine.***—Track laid in 1889, Shore Line Junction to Riviere Junction, 1.95 miles.

40. ***Grafton & Upton.***—Track laid in 1889, West Upton to Hopedale, 6.5 mile. Track laid in 1890, Hopedale to end of track, 1.55 miles. Graded, end of track to Milford, 0.2 mile.

41. ***Old Colony.***—Under construction, North Attleboro to Wrentham, 12.85 miles.

Projects and Surveys.

42. ***Cochituate Branch.***—Under survey, Wayland to Cochituate, 3 miles. Chief Engineer, Henry A. Hancox, Hudson.

43. ***Marlboro & Sudbury.***—Surveyed, Marlboro to South Sudbury, 6.1 miles. Chief Engineer, Henry A. Hancox, Hudson.

44. ***Plymouth & Bournedale.***—Under survey, Plymouth to Bournedale, 22 miles. Chief Engineer, Henry A. Hancox, Hudson.

45. ***Plymouth & Middleboro.***—Projected, Plymouth to Middleboro, 16 miles. Chief Engineer, Jas. M. Hoge, Plymouth.

46. ***United States Central.***—Projected, Boston to Hartford, Conn., 104 miles. President, John Gilman, Worcester.

Total.—Track laid in 1889, 8.45 miles. Track laid since Jan. 1, 1890, 0.2 miles. In process of construction, 14.4 miles. Surveyed or under survey, 54.1 miles. Projects of some promise, 86 miles.

CONNECTICUT.—Existing Roads.

47. ***Central New England & Western.***—Surveyed, Tariffville to Springfield, Mass., 18 miles.

48. ***Meriden & Western.***—Track laid in 1889, end of track to Waterbury, 0.5 miles.

49. ***New York, New Haven & Hartford.***—Projected, Watertown to Woodbury, 6 miles; New Britain to Farmington Station, 6 miles.

50. ***New York, Providence & Boston.***—Track laid in 1889, connections with the Thames River bridge, New Haven, 5.13 miles.

51. ***Shepaug, Litchfield & Northern.***—Projected, New Preston to Lake Waramaug, 4 miles.

Projects and Surveys.

52. ***Rockville & Portland.***—Projected, Rockville to Portland, 30 miles. N. T. Pulsifer, Manchester.

53. ***Westerly & Jewett City.***—Surveyed, Westerly to Volunton, 25 miles. Chief Engineer, Thomas F. Chappell, Pawtucket, R. I., C. Chamberlain, Westerly, R. I.

Total.—Track laid in 1888, 5.63 miles. Surveyed or under survey, 36 miles. Projects of some promise, 116 miles.

RHODE ISLAND.—Existing Roads.

54. ***Seaview.***—Under construction, Wickford to Narragansett, 8 miles. W. B. Blunding; Wm. C. Clark.

Projects and Surveys.

55. ***Rhode Island Western.***—Projected, Providence, R. I., to Springfield, Mass., 72 miles.

56. ***Woonsocket & Huntsville.***—Projected, Woonsocket to Huntsville, 12 miles. President, Henry Lippett; Vice-President, Oscar J. Rathburn.

Total.—In process of construction, 8 miles. Projects of some promise, 32 miles.

NEW YORK.—Existing Roads.

57. ***Brookfield.***—Under contract, North Brookfield to Brookfield, 7 miles. Chief Engineer, Walter F. Randall, Oneida; Secretary, M. L. Brown, Brookfield.

58. ***Buffalo, Rochester & Pittsburg.***—Track laid in 1889, Lincoln Park to Chariotte, 10.89 miles.

59. ***Carthage & Adirondack.***—Track laid in 1889, Oswegatchie to Little River, 4 miles. Projected, Little River to Big Tupper Lake, 30 miles.

47. ***Central New England & Western.***—Track laid in 1889, Campbell Hall to Silvernails, 57.6 miles.

60. ***Central R. R. of New Jersey.***—Track laid in 1889, Greycourt to Burnside, 10.5 miles.

61. ***Chateaugay.***—Under construction, Plattsburg to Maine Mills, 2 miles. Surveyed, Saranac Lake to Lake Placid, 8 miles.

62. ***Cooperstown & Charlotte Valley.***—Track laid in 1889, Cooperstown Junction to West Davenport, 6 miles. Under construction, West Davenport to Davenport Centre, 6 miles. Surveyed, Davenport Centre to East Davenport, 2 miles.

63. ***Delaware & Hudson Canal Co.***—Adirondack R. R.—Projected, North Creek to Long Lake, 42 miles.

64. ***Fulton Chain.***—Track laid in 1889, Moose River to Minnehaha, 8 miles.

5. ***Grand Trunk.***—Track laid in 1889, Bombay to Moira, 9 miles.

65. ***Hudson Suspension Bridge & New England.***—Under construction, Connecticut line to Turner's Station, with New Jersey connection, 40 miles. President, Edward W. Serrell, 38 Wall street, New York City; Secretary, Geo. D. Beach.

66. ***Jones Mountain.***—Track laid in 1889, Hudson to Becroft Mountain, 3 miles. Surveyed, Becroft Mountain to Jonesburg, 12 miles. President, Fred. W. Jones, Jonesburg.

67. ***Kanona & Prattsburg.***—Track laid in 1889, Kanona to Prattsburg, 11.44 miles.

68. ***Keeseville, Ausable Chasm & Lake Champlain.***—Track laid in 1889, Port Kent to Keeseville, 5.6 miles.

69. ***Kinderhook & Hudson.***—Under construction, Kinderhook to Hudson, 16.5 miles. President, R. H. Huntington, Watertown; Chief Engineer, E. G. Ferris, Hudson.

70. ***Lackawanna & Southwestern.***—Projected, Wayland to Geneva, 40 miles.

71. ***Lehigh Valley.***—Auburn & Ithaca R. R.—Under construction, Freeville to Ithaca, 8.5 miles. Buffalo & Geneva R. R.—Under contract, Buffalo to Geneva, 98 miles. Geneva & Van Ettenville R. R.—Surveyed, Geneva to Van Ettenville, 57 miles.

72. ***Long Island.***—Track lines in 1889, Locust Valley to Oyster Bay, 4 miles.

New York & Sea Beach.—Track laid in 1889, King's Highway to Race Track, 0.5 miles.

73. ***New York, Ontario & Western.***—Track laid in 1889, New Berlin to Edmeston, 6.8 miles.

74. ***Pennsylvania, Poughkeepsie & Boston.***—Track laid in 1889, Pine Island to New Jersey State line, 5 miles.

75. ***Port Jervis, Monticello & New York.***—Projected, Monticello to Jefferson, 18 miles.

76. ***Rochester & Glen Haven.***—Track laid in 1889, Rochester to Glen Haven, 3.5 miles.

77. ***Ulster & Delaware.***—Track laid in 1889, Hobart to Bloomville, 8.5 miles. Partly graded, Bloomville to Oneonta, 22 miles. Projected, Bloomville to Delhi, 8 miles.

78. ***Utica & Unadilla Valley.***—Track laid in 1889, Bridgewater south, 1 mile. Partly graded, end of track to New Berlin, 19 miles. President, A. C. Couch, 35 Broadway, New York City. Chief Engineer, Delos E. Culver, 146 Broadway, New York City.

79. ***Wellsville, Coudersport & Pine Creek.***—Under contract, Coudersport, Pa., to Wellsville, N. Y., 28 miles. President, John McElvin, Coudersport, Pa.; Vice-President, E. J. Farnum, Coudersport.

80. ***West Shore.***—Under survey, Albany to Fuller's Station, 13 miles.

Projects and Surveys.

81. ***Buffalo & Williamsville.***—Projected, Buffalo to Williamsville, 10 miles. President, B. J. Tillman, 404 Main St., Buffalo.

82. ***Cooperstown & Katskill.***—Surveyed, East Davenport to Cairo, 61.5 miles. W. S. Church, Albany.

83. ***Delaware & North River.***—Surveyed, Summitville to Kingston, 40 miles. President, Isaa N. Cox, Ellenville; Vice-President, Peter E. Farnum, Port Jervis; Secretary, Charles St. John, Port Jervis.

84. ***Dexter & Ontario.***—Surveyed, Dexter to Brownsville, 2 miles. President, J. A. Outterson, Dexter; Secretary, J. L. Newton, Watertown.

Dunderburg Spiral.—Surveyed, gravity railway at Mt. Dunderburg, 15 miles. President, Jas. Morgan; Chief Engineer, Ira E. Hartwell, Wilkesbarre, Pa.; Promoters, P. L. Mumford and N. J. Mumford, Mauch Chunk, Pa.

85. ***Fort Plain & Richfield Springs.***—Surveyed, Fort Plain to Richfield Springs, 20 miles. President, A. C. Couch, 35 Broadway, New York City.

86. ***Hornellsville & West Union.***—Projected, Hornellsville to West Union, 16 miles. President, Benton McConnell; Chief Engineer, C. N. Wickham; Chas. Adsit, Hornellsville.

87. ***Little Falls, Van Hornellsville & Richfield Springs.***—Projected, Little Falls to Richfield Springs, 7 miles. Chief Engineer, S. E. Burdick, Little Falls.

88. ***Lockport & Northern.***—Projected, Lockport to New Fane Station, 10 miles. President, Wm. Spaulding; Vice-President, Wm. T. Ransom; both of Lockport.

89. ***Neversink Valley.***—Surveyed, Fallsburg to Neversink, 10 miles. President, Wm. R. Royce; Vice-President, John W. Low; both of Middletown; Chief Engineer, G. T. Richards, Pittsburg, Pa.

90. ***Oneida, Oneonta & New York.***—Surveyed, Oneida to Oneonta, 75 miles. President, J. W. Warner, Oneida.

91. ***Oneonta & Earlville.***—Surveyed, Laurens to Earlville, 42 miles. President, A. C. Couch, 35 Broadway, New York City.

92. ***Oneonta & Richfield Springs.***—Surveyed, Oneonta to Richfield Springs, 32 miles. President, A. C. Couch, 35 Broadway, New York City.

93. ***Poughkeepsie & Hudson.***—Surveyed, East Park to Livingston, 41 miles. President, J. V. Clark, Syracuse; Chief Engineer, E. N. Burlingame, Providence, R. I.

94. ***Poughkeepsie & Southeastern.***—Located, Poughkeepsie to Hopewell, 11.2 miles. President, E. L. Dwyer; Chief Engineer, H. F. Keith, Poughkeepsie.

95. ***Rochester & Honeoye Valley.***—Surveyed, Rochester to Honeoye Falls, 16.5 miles. Secretary, Geo. Foss, Rochester.

96. ***Rome & Carthage.***—Surveyed, Rome to Carthage, 56 miles. President, James C. Smith, Rome.

97. ***Saratoga, Johnstown & Western.***—Surveyed, Utica to Saratoga, 75 miles. President, Wm. Clark, Fort Plain.

98. ***Schenectady & Albany.***—Surveyed, Schenectady to Albany, 15 miles. President, Verplanck Colvin; Chief Engineer, James Brown; both of Albany.

99. ***Troy & New England.***—Under survey, Troy to Lebanon Valley R. R., 35 miles. President, Walter P. Warren, Troy; Chief Engineer, C. E. Fogg, Poughkeepsie.

100. ***Washington County.***—Surveyed, Greenwich, N. Y., to Rutland, Vt., 56 miles. Chief Engineer, J. S. Chase, 38 Wall St., New York City.

Total.—Track laid in 1889, 155.33 miles. Track laid since Jan. 1, 1890, 3 miles. In process of construction, 234 miles. Surveyed or under survey, 670.2 miles. Projects of some promise, 184 miles.

NEW JERSEY.—Existing Roads.

101. ***Baltimore & Ohio.***—Track laid in 1889, Crawford to Arthur Kill bridge, 7 miles.

102. ***Brigantine Beach.***—Track laid in 1889, Pomona Station to Grassey Bay, 10 miles.

60. ***Central R. R. of New Jersey.***—Track laid in 1889, Lorillard to Hopping, 3.91 miles. Projected, Phillipsburg to Belvedere, 12.5 miles; Seabright to Atlantic Highlands, 5 miles.

103. ***Delaware, Lackawanna & Western.***—Surveyed Peapack to Bernardsville, 5 miles.

104. ***Keyport.***—Track laid in 1889. Keyport to Thomas Creek, 2.5 miles.

71. ***Lehigh Valley.***—Under construction, Roselle to Newark, 6.75 miles.

105. ***New York, Susquehanna & Western.***—Surveyed, Maywood to Monsey, 15 miles.

106. ***Palisades.***—Under construction, Weehawken to Piermont, N. Y., 30 miles. Secretary, Wm. S. Coe, New York City.

107. ***Pennsylvania***—Under construction, Waverly to Meadows Yard, 4 miles.

74. ***Pennsylvania, Poughkeepsie & Boston.***—Track laid in 1889, New York State line to Swartwood, 20 miles; Hainesburg to Pennsylvania State line, 2 miles. Under survey, Hainesburg to Swartwood, 18.5 miles.

108. ***Philadelphia & Reading.***—Under survey, Mount Ephraim to Spring Mills, 8 miles.

109. ***Philadelphia & Seashore.***—Track laid in 1890, Winslow Junction to Folsom, 4 miles. Under construction, Folsom to Sea Isle City, 31 miles. President, Chas. W. Pates; Chief Engineer, G. A. Benson, both of Philadelphia, Pa.

110. ***Raritan River.***—Track laid in 1889, South River to New Brunswick, 6 miles; South River to Sayreville, 0.3 miles. Under construction, New Brunswick to Bound Brook, 7 miles. Chief Engineer, A. W. Harrison, Fuller Building, Jersey City.

111. ***Rockaway Valley.***—Track laid in 1889, New Germantown to Peapack, 7.2 miles. Projected, Peapack to Morristown, 15 miles.

Projects and Surveys.

112. ***Trenton & Atlantic.***—Surveyed, Trenton to Point Pleasant, 42.5 miles. Chief Engineer, C. C. Vermeule, 71 Broadway, New York City.

Total.—Track laid in 1889, 58.9 miles. Track laid since Jan. 1, 1890, 4 miles. In process of construction, 73.75

miles. Surveyed or under survey, 59 miles. Projects of some promise, 82.5 miles.

DELAWARE.—Existing Roads.

Wilmington & Northern.—Track laid in 18 9, Delaware River extension, 0.2 miles.

Total.—Track laid in 1889, 0.2 miles.

MARYLAND.—Existing Roads.

113. *Baltimore & Annapolis.*—Track laid in 1889, Gidding to Annapolis, 1 mile.

114. *Baltimore & Drum Point.*—Under construction Baltimore to Drum Point, 82 miles; 62 miles graded. Surveyed, Conway's to Washington, 20 miles. Chief Engineer, Nicholas Goldsborough, 10 South Broad St., Baltimore.

115. *Baltimore & Eastern Shore.*—Track laid in 1889, Easton to St. Michaels, 11 miles. Under construction, Easton to Salisbury, 40 miles. President, Jas. B. Seth, Easton.

101. *Baltimore & Ohio.*—Projected, Boyd's to Seneca, 10 miles.

Baltimore & Sparrows Point.—Track laid in 1889, Sparrows Point to Penwood Park, 0.8 miles.

116. *Confluence & Oakland.*—Track laid in 1889, Pennsylvania State line to Manor Lands, 7.5 miles.

117. *Deer Creek & Susquehanna.*—Under construction, Bel Air to Stafford, 16 miles. Under survey, Stafford to Havre de Grace, 9 miles. President, George M. Jewett, Glenville.

118. *Washington & Potomac.*—Projected, Mechanicsville to Point Lookout, 45 miles.

119. *Western Maryland.*—Track laid in 1889, Pennsylvan'a State line to Highfield, 25 miles. Surveyed, Arlington to Colgate Creek, 8 miles.

Projects and Surveys.

Baltimore Belt.—Projected, Camden Station to Bay View Junction, in the city of Baltimore, 7 miles. President, Wm. Gilmor; Chief Engineer, Samuel Rea; both of Baltimore.

120. *Cumberland & Washington.*—Projected, Cumberland to Washington, 184 miles. Enoch Pratt, Baltimore, Asa Wilson, Cumberland.

121. *Maryland Midland.*—Projected, Northern Central R. R. north, 25 miles. Chas. A. Councilman; Howard Munnikhuysen, Baltimore.

Total.—Track laid in 1889, 20.55 miles. In process of construction, 138 miles. Surveyed or under survey, 101 miles. Projects of some promise, 271 miles.

PENNSYLVANIA.—Existing Roads.

122. *Allegheny & Kinzua.*—Projected, branches to timber lands, 30 miles.

101. *Baltimore & Ohio.*—Under construction, Taylorstown to Hornstone quarries, 2 miles; under survey, McKeesport to Jeannette, 15 miles.

123. *Bangor & Portland.*—Surveyed, Pen Argyle to Wind Gap, 2.5 miles.

124. *Bellefonte & Buffalo Run.*—Track laid in 1889, Bellefonte to Buffalo Run, 18 miles.

58. *Buffalo, Rochester & Pittsburg.*—Track laid in 1889, Big Run to Elnora Mines, 4.94 miles.

60. *Central R. R. of New Jersey.*—Under construction, Easton, Pa., to Phillipsburg, N. J., 1 mile.

125. *Clearfield & Jefferson.*—Track laid in 1889, Horatio to No. 3 mines, 1.25 miles.

116. *Confluence & Oakland.*—Track laid in 1889, Confluence to Maryland State line, 13 miles.

126. *Cornwall.*—Projected, Cornwall to Lancaster, 18 miles; Cornwall to Middleton, 18 miles.

127. *Cornwall & Lebanon.*—Track laid in 1889, Mount Gretna Park to Governor Dick Mountain, 4 miles. Projected, Belt line at Lebanon, 3 miles.

128. *Coudersport & Port Allegheny.*—Surveyed, Coudersport to Ansonia, 38 miles.

129. *Cumberland Valley.*—Under survey, Fort London to Mt. Dallas, 46 miles.

130. *Delaware River & Lancaster.*—Track laid in 1889, Phœnixville, northwest, 7 miles. Under survey, end of track to Lancaster, 33 miles.

131. *Diamond Valley.*—Track laid in 1889, Globe Run to Morrisville, 4 miles.

132. *Easton & Northern.*—Track laid in 1889, Bangor & Portland R. R. southeast, 2.5 miles. Track laid in 1890, end of track southeast, 3 miles. Under construction, end of track to Easton, 4 5 miles.

133. *Gettysburg & Harrisburg.*—Surveyed, Gettysburg to Washington, D. C., 75 miles. Projected, main line to Baltimore, 25 miles.

134. *Johnsonburg.*—Track laid in 1889, Johnsonburg to Claremont, 20 miles.

135. *Johnsonburg & Bradford.*—Under construction, Johnsonburg to Bradford, 35 miles. Chief Engineer, J. M. Floesch, Bradford.

136. *Lehigh and Lackawanna.*—Wind Gap and Delaware R. R.—Projected, Saylorsburg to Stroudsburg, 6 miles.

71. *Lehigh Valley.*—Track laid in 1889, Allentown to Furnace, 2.2 miles; extension of Loyalsock R. R., 3.7 miles.

137. *McKeesport & Belle Vernon.*—Track laid in 1889, Elizabeth to Belle Vernon, 18.9 miles.

138. *Middletown & Hummelstown.*—Track laid in 1889, Middletown to Stoverdale, 5 miles.

139. *Mount Jewett, Kinzua & Ritterville.*—Track laid in 1889, Mt. Jewett to Doyles, 5 miles.

140. *New York, Lake Erie & Western.*—Located, Carbondale to Honesdale, 14 miles.

73. *New York, Ontario & Western.*—Track laid in 1889, Scranton to Providence, 2 miles. Track laid in 1890, Hancock, N. Y., to Delaware River, 3 miles. Under construction, Delaware River to Providence, 49.5 miles.

107. *Pennsylvania.*—Track laid in 1889, Monarch to New Hope, 5 miles; Mt. Pleasant to Scottdale Branch Junction, 5 miles. Under construction, Morrisville to Dowrington, 52 miles; end of track to Jack's Run, 2 miles; Radebaugh to Aroona, 9 miles; New Holland to Lancaster, 11 miles. Projected, Butler Branch to Winfield Furnace, 10 miles; McKeesport to Bessemer, 4 miles.

141. *Pennsylvania, Lehigh & Eastern.*—Graded, Matamoras west, 10 miles. Surveyed, end of grade to Tomhicken, 20 miles. President, Samuel F. Pierson, Chief Engineer, S. N. Haight; both of 111 Broadway, New York City.

74. *Pennsylvania, Poughkeepsie & Boston.*—Track laid in 1889. New Jersey line to Slatington, 28 miles. Under survey, Slatington to Harrisburg, 101 miles; Pen Argyle to Benders, 8 miles.

142. *Perry County.*—Track laid in 1889, Duncannon to New Bloomfield, 11.2 miles.

108. *Philadelphia & Reading.*—Track laid in 1889, Rupert to Bloomsburg, 1.8 miles. Under construction, Bowmansdale to Harrisburg, 10 miles; Hartsville to New Hope, 16 miles. Surveyed, Quarryville to Oxford, 16 miles. Projected, Kalmig to Clark's Valley, 5 miles. Terminal line at Philadelphia, 4 miles; Lofty to coalfields, 25 miles.

143. *Pittsburg, Shenango & Lake Erie.*—Partly graded, Amasa, Pa., to Conneaut, O., 50 miles.

144. *Schuylkill & Lehigh Valley.*—Located, Bowman's Station to Tremont, 50 miles.

145. *Southwestern Pennsylvania.*—Track laid in 1889; Latrobe to coke ovens, and Latrobe to Latrobe steel works, 9 miles.

146. *Titusville, Cambridge & Lake Erie.*—Partly graded, Titusville to Erie, 50 miles. President, C. N. Steel; Chief Engineer, F. P. James, Titusville.

147. *Turtle Creek Valley.*—Partly graded, Stewart's to Murrysville, 6 miles. Surveyed Murrysville to Saltsburg, 17 miles.

119. *Western Maryland.*—Track laid in 1889, Fairfield to Maryland State line, 10.75 miles.

148. *Wilkesbarre & Western.*—Surveyed, Rohrsburg to Shickshinny, 15 miles.

149. *Williamsport & Binghamton.*—Track laid in 1889, Dushore to Towanda, 20 miles. Located, Williamsport to Dushore, 45 miles. Projected, Towanda to Binghamton, 45 miles. Chief Engineer, P. E Alden, Monroetown.

150. *Williamsport & North Branch.*—Projected, Nordmont to Bernice, 17 miles; Halls to Williamsport, 10 miles.

151. *Wilmington & Northern.*—Surveyed, Joanna Station to Joanna Furnace, 2 miles.

Projects and Surveys.

152. *Bellefonte & Eastern.*—Projected, Bellefonte to Watsontown, 75 miles.

153. *Clarion River.*—Projected, Carman to Hailton, 12 miles. President, Wm. H. Hyde. Chief Engineer, B. E. Wellendorf, Ridgeway.

154. *Hornellsville & Coudersport.*—Projected, Coudersport to New York State line, 22 miles. President, N. J. Peck, Coudersport.

155. *Kettle Creek.*—Surveyed, Westport to Trout Run, 14 miles. President, Edgar Thompson, Williamsport.

156. *Lackawanna & Montrose.*—Surveyed, Montrose to Montrose Station, 10 miles. H. F. Beardsley, Montrose.

157. *Oley Valley & Lehigh.*—Projected, Birdsboro to Rittenhouse Gap, 21 miles. President, Geo. Brooke, Birdsboro.

158. *Pittsburg, Cannonsburg & State Line.*—Under survey, Pittsburg, Pa., to Wheeling, W. Va., 63 miles. President, Chas. Meyran, Chief Engineer, R. L. McCully; both of Pittsburg.

Total.—Track laid in 1889, 202.24 miles. Track laid since Jan. 1, 1890, 3 miles. In process of construction, 335 miles. Surveyed or under survey, 558.5 miles. Projects of some promise, 390 miles.

OHIO.—Existing Roads.

159. *American Midland.*—Track laid in 1889, Ottawa to Glandorf, 2 miles. Partly graded, Glandorf to Ft. Wayne, Ind., 55 miles.

160. *Cincinnati, Wheeling & New York.*—Surveyed, Morgan Junction to Freeport, 20 miles.

161. *Cleveland, Akron & Western.*—Under contract, Akron to Cary, 109 miles. President, Wm. H. Semple, Jr., Allegheny, Pa. Chief Engineer, John A. Semple, Akron.

162. *Cleveland & Canton.*—Track laid in 1889, Coshocton to Zanesville, 30 miles; at Kenton, O., 0.7 miles. Projected, Solon to Chagrin Falls, 3 miles.

163. *Columbus, Lima & Milwaukee.*—Under construction, Lima to Defiance, 40 miles. Surveyed, Lima to Columbus, 80 miles. Projected, Defiance to Allegan, 145 miles. President, B. C. Furot, Lima.

164. *Lancaster & Hamden.*—Track laid in 1889, Tarlton to Cincinnati and Muskingum Valley Junction. Under construction, Hadley Junction to Wellston, 62 miles. Under survey, C. & M. V. Junction to Columbus, 26 miles; Ash Circle to Floodwood, 25 miles; Point Pleasant, Adelphi, & Northwestern, track laid in 1889, Vinton to Vinton Station, 5 miles. Located between Point Pleasant and Washington C. H., 80 miles. This road uses 16 miles of Lancaster & Hamden R. R. tracks. Contractors, E. P. Buell & Co., Tarlton.

165. *Ohio & Northwestern.*—Projected, Sardinia to Georgetown, 12 miles.

166. *Pittsburg, Marion & Chicago.*—Projected, New Lisbon to Minerva, 20 miles.

167. *Port Clinton Short Line.*—Track laid in 1889, Short Line junction to Salem, 2 miles. Partly graded, Port Clinton to Fremont, 20 miles.

168. *Sandusky, Ashland & Coshocton.*—Under contract, Sandusky to Ashland, 50 miles. President, G. C. Gardiner. Chief Engineer, Charles A. Judson, both of Sandusky.

169. *Scioto Valley.*—Track laid in 1889, Portsmouth Junction to Scioto Junction, 5.33 miles.

170. *Toledo, Columbus & Cincinnati.*—Track laid in 1889, Findlay to Kenton, 23 miles. Located, Kenton to Columbus, 62 miles. Chief Engineer, J. C. Williams, Kenton.

171. *Toledo, Findlay & Springfield.*—Track laid in 1889, North Baltimore to Bowling Green, 15 miles. Projected, Toledo to Bowling Green, 21 miles; North Baltimore to Springfield, 84 miles. Superintendent, T. B. Brown, Toledo.

172. *Wheeling & Lake Erie.*—Track laid in 1889, Bowerstown to Portland, 34 miles. Under construction, Portland to Steubenville, 14 miles. Under survey, Portland to Bellaire, 12 miles; Adena to St. Clairsville Junction, 17 miles.

173. *Zanesville & Ohio River.*—Track laid in 1889, Rendville to Drakes, 2.6 miles.

Projects and Surveys.

174. *Cleveland & Chicago.*—Projected, Cleveland to Napoleon, 125 miles. W. J. Hilands, 5 Euclid Ave., Cleveland.

175. *Hocking & Western.*—Projected, London to Athens, 90 miles. President, H. B. Cramer, New York City; Vice-President, G. R. Carr, Columbus.

176. *Sandusky, Columbus, Lake Erie & Southern.*—Surveyed, Sandusky to Columbus, 110 miles. President, John McKelvey; Chief Engineer, Chas. A. Judson, both of Sandusky.

177. *Tiffin & Freemont.*—Surveyed, Marblehead to Upper Sandusky, 75 miles. President, J. O. Sloan, Lakeside; Chief Engineer, J. G. Kaney, Lakeside.

178. *Walhonding Valley.*—Under survey, Kimbalton to Mansfield, 84 miles. President, A. J. Warner, Marietta. Chief Engineer, J. A. Hanlon, Canton.

Total.—Track laid in 1889, 125.63 miles. In process of construction, 335 miles. Surveyed or under survey, 621 miles. Projects of some promise, 418 miles.

INDIANA.—Existing Roads.

179. *Canada & St. Louis.*—Projected, Goshen to La Crosse, 60 miles.

180. *Cincinnati, Wabash & Michigan.*—Projected, Anderson to Rushville, 40 miles.

181. *Cleveland, Cincinnati, St. Louis & Chicago.*—Surveyed, Louisville, Ky., to Aurora, Ind., 100 miles.

182. *Evansville & Terre Haute.*—Track laid in 1889 Old Pittsburg to Old Pittsburg Junction, 4.1 miles; Elnora to Sand Creek, 82.5 miles. Under contract, Sand Creek to Richmond, 70 miles. Projected, Jasper to Washington, 30 miles.

183. *Evansville, Suburban & Newburg.*—Track laid in 1889, Evansville to Newburg, 10.5 miles.

184. *Indiana & Lake Michigan.*—Track laid in 1889, South Bend to Michigan State line, 14.3 miles.

185. *Indianapolis & Vincennes.*—Track laid in 1889, Gosport to North Bedford, 4.5 miles. Projected, North Bedford to Eiletsville, 4 miles.

186. *Louisville, New Albany & Chicago.*—Projected, Main Line to Indianapolis, 90 miles.

187. *Louisville, New Albany & Corydon.*—Track laid in 1889, Corydon to King's Cave, 4 miles; in city of Indianapolis, 1.25 miles.

188. *Ohio & Mississippi.*—Under construction, Mill Creek to Tanyard Branch quarries, 6 miles.

189. *Ohio Valley.*—Track laid in 1889, Kentucky State line to Evansville, 4 miles.

190. *Wabash.*—Projected, Wabash to Laketon, 13 miles.

Projects and Surveys.

191. *Evansville, Ft. Wayne & Chicago.*—Surveyed, Lafayette to Fort Wayne, 109 miles. H. K. Drew, Indianapolis.

Montpelier & Chicago.—Projected, Montpelier to Chicago, 210 miles. President, D. Stauffer; Secretary, Geo. Strayer, both of Montpelier.

192. *New York, Fort Wayne & Chicago.*—Projected, Fort Wayne to East Chicago, 134 miles. President, John Lee, Crawfordsville; Chief Engineer, T. S. Armstrong, Syracuse, Ill.; W. C. Frank, Warsaw.

193. *Terre Haute & Mississippi River.*—Projected, Terra Haute to Chester, Ill., 18 miles. President, H. Hulman, Terre Haute.

194. *Toledo & Chicago Air Line.*—Projected, Toledo to Chicago, Ill., 225 miles. President, M. Mercer; Vice-President, W. L. Stone, both of Goshen

195. *Vincennes & New Albany.*—Projected, New Albany to Vincennes, 126 miles. President, Edward Watson, Vincennes.

196. *Vincennes, Oakland City & Owensboro.*—Surveyed, Vincennes to Owensboro, Ky., 70 miles. President, Edward Watkins, Vincennes; Chief Engineer, W. B. Eells, Owensboro, Ky.

Total.—Track laid in 1889, 125.15 miles. In process of construction, 96 miles. Surveyed or under survey, 279 miles. Projects of some promise, 860 miles.

MICHIGAN—Existing Roads.

197. *Au Sable & Northwestern.*—Track laid in 1889, Au Sable to Potts, 38 miles. Projected, Potts to Hillman, 18 miles. Chief Engineer, J. F. Wilson, Potts.

198. *Central Michigan.*—Projected, Rogers City to Lowell, 200 miles; Hastings to Garrett, Ind., 90 miles. President, J. W. Boynton; Chief Engineer, J. N. Roberts; both of Grand Rapids.

Chicago & Northwestern.—Under contract, Beachwood to Section 9, Township 10, 7 miles.

199. *Chicago & West Michigan.*—Track laid in 1889, Baldwin to Munster River, 28 miles; Traverse City south, 7 miles. Track laid in 1890, end of 1889 track south of Traverse City, south 30 miles. Under construction, between ends of track, 10 miles. Under survey, Traverse City to Charlevoix, 62 miles; Williamsburg to Elk Rapids, 9 miles.

200. *Chicago, Kalamazoo & Saginaw.*—Track laid in 1889, Hastings to Woodbury, 15 miles.

201. *Cincinnati, Jackson & Mackinaw.*—Surveyed, Addison to Jackson, 20 miles.

202. *Cincinnati, Saginaw & Mackinaw.*—Surveyed, Bay City to Tawas City, 55 miles.

203. *Detroit, Charlevoix & Escanaba.*—Under construction, Petoskey City to Charlevoix, 16.5 miles. Located, Mackinaw to Petoskey City, 20 miles; Charlevoix to Harrison, 133 miles. President, R. M. Cherrie; Chief Engineer, S. N. Beardslee; both of Charlevoix.

204. *Flint & Pere Marquette.*—Track laid in 1889, belt line at Saginaw and East Saginaw, 8.12 miles. Track laid in 1890, Yale to Port Huron, 34 miles; Brown City south, 5 miles. Projected, Novi to Detroit, 25 miles.

205. *Grand Rapids & Indiana.*—Under construction, Round Lake to Lake City, 7 miles. Projected, Ludington to Big Rapids, 42 miles. Chief Engineer, G. S. Johnson, Grand Rapids.

Hecla & Torch Lake.—Track laid in 1889, Hecla to Red Jacket shaft, one mile.

Indianapolis & Lake Michigan.—Track laid in 1889, Indiana State line to St. Joseph, 25 miles.

206. *Manistee & Grand Rapids.*—Under construction, Manistee south, 2 miles. Projected, end of grade to Grand Rapids, 108 miles. President, John Canfield; Chief Engineer, G. W. Meunschen, Manistee.

207. *Manistee & Northeastern.*—Track laid in 1889, Bear Creek to Nessen City, 24 miles; Bear Creek to Peters

Gap, 4.25 miles. Located, end of track to Traverse City' 26 miles.

Milwaukee & Northern.—Track laid in 1889, Adventure Creek to Duluth, South Shore & Atlantic R. R., 26 miles. Projected, Escanaba to Iron Mountain, 75 miles.

208. *Toledo, Ann Arbor & North Michigan.*—Track laid in 1889, Springville to Benzie County line, 24 miles. Under construction, Benzie County line to Frankfort, 19 miles. Surveyed, Mount Pleasant to Big Rapids, 40 miles. Projected, Ann Arbor to Detroit, 29 miles.

Projects and Surveys.

209. *Detroit & St. Clair River.*—Surveyed, Detroit to St. Clair, 48 miles. President, C. McElroy, St. Clair.

210. *Grand Rapids & Lake Michigan.*—Projected, Grand Rapids to South Bend, 75 miles. Chas. E. Temple Grand Rapids.

Grand Rapids & Mineral Springs.—Surveyed, Grand Rapids to Mineral Springs, 2 5 miles. President, C. S. Edwards; Chief Engineer, F. W. Stevens; both of Grand Rapids.

Lansing & Northern.—Located, Lansing north, 100 miles. President, Arthur A. Bement, Lansing; Chief Engineer, Quincy A. Thomas, Oxford.

Total.—Track laid in 1889, 200.37 miles. Track laid since Jan. 1, 1890, 39 miles. In process of construction, 61.5 miles. Surveyed or under survey, 630.5 miles. Projects of some promise, 632 miles.

VIRGINIA.—Existing Roads.

Atlantic & Danville.—Track laid in 1889, Hodges Ferry to Portsmouth, 6 miles; Danville to North Carolina State line, 2 miles; North Carolina State line to Clarksville, 25 miles. Under construction, main line to Buffalo Lithia Springs, 3 miles. Under survey, Danville to Bristol, 175 miles.

212. *Chesapeake & Ohio.*—Projected, Clifton Forge to Warm Springs, 22 miles.

213. *Craig Mineral.*—Under construction, Eagle Rock to New Castle, 25 miles. President, J. W. Marshall; General Manager, W. G. Sears; both of New Castle.

214. *Cumberland Valley.*—Track laid in 1889, Martinsburg to West Virginia State line, 9 miles.

215. *Farmville & Powhatan.*—Track laid in 1889, Clover Hill to Sunnyside, 34 miles. Track laid in 1890, Sunnyside to Farmville, 25 miles. Located, Farmville to Hampden Sidney College, 7 miles. Projected, Hampden Sidney College to Brookneal, 38 miles.

216. *Lynchburg & Durham.*—Track laid in 1889, Rustburg to South Boston, 49 miles. Track laid in 1890, South Boston south, 12 miles. Under construction, end of track to Durham, N. C., 32 miles; belt line at Lynchburg, 7 miles.

Norfolk & Carolina.—Track laid in 1889, Drivers to North Carolina State line, 22 miles; Armsteads to Prince's Point, 2 9 miles.

Norfolk & Western.—Clinch Valley Division—Track laid in 1889, end of track to Honaker, 31.3 miles. Track laid in 1890, Honaker to Bickley's Mills, 19.2 miles. Under construction, Bickley's Mills to Norton, 26.3 miles; Branch to Burton's Point, 10 miles. Chamber's Valley and New River R.R.—Under construction, Ivanhoe to Great Outburst, 16 miles. Surveyed, Great Outburst to North Carolina State line, 5 miles.

217. *Orange & Keysville.*—Under contract, Orange C. H. to Keysville, 35 miles; 17 miles under construction. Chief Engineer, Thos. Moore, 912 East Main street, Richmond.

Richmond & Seven Pines.—Track laid in 1889, Richmond to Seven Pines, 8 miles.

Richmond, Fredericksburg & Potomac.—Under contract, connecting link with Richmond & Petersburg R. R., near Richmond, 8 miles. Contractors, Mason, Gooch & Hoge, Frankfort, Ky.

South Atlantic & Ohio.—Track laid in 1889, Speer's Ferry to Natural Tunnel, 55 miles. Track laid in 1890, Natural Tunnel towards Big Stone Gap, 20 miles. Under construction, end of track to Big Stone Gap, 46 miles.

218. *Staunton & West Augusta.*—Under contract, Staunton to Dora Coal Fields, 25 miles. President, R. N. Pool, Staunton. Engineers, Hill & Stout, 42 Broadway, New York City.

Surrey, Sussex & Southampton.—Track laid in 1889, Wakefield to Scotland, 20 miles.

Projects and Surveys.

Virginia & Kentucky.—Projected, Danville to Kentucky State line, 200 miles. President, David S. Pierce, Wytheville; Chief Engineer, J. E. Wrenshall, Danville.

219. *Washington Western.*—Projected, Warrenton to Luray, 50 miles. President, F. J. Kimball.

Total.—Track laid in 1889, 214.7 miles. Track laid since Jan. 1, 1890, 74.2 miles. In process of construction, 219.9 miles. Surveyed or under survey, 187 miles. Projects of some promise, 310 miles.

WEST VIRGINIA.—Existing Roads.

101. *Baltimore & Ohio.*—Projected, Phillippi to Elkins, 25 miles.

Chesapeake & Ohio.—Under construction, New River to Riverview, 2.5 miles.

214. *Cumberland Valley.*—Track laid in 1889, Virginia State line to Winchester, 13.5 miles.

220. *Kanawha.*—Graded, Fairfield to mines, 9 miles.

221. *Monongahela River.*—Track laid in 1889, Fairmount to Shinnston, 18 miles. Under construction, Shinnston to Clarksburg, 17 miles. President, J. A. Camden, Parkersburg.

222. *Norfolk & Western.*—Elkhorn Extension.—Under construction, Forks of Elkhorn to Ironton, O., 195 miles; Richlands up Big Creek, 4 miles.

223. *Ohio River.*—Ravenswood, Spencer & Glendale R. R.—Projected, Ravenswood to Spencer, 25 miles.

119. *Western Maryland.*—Potomac Valley R. R. Surveyed, Williamsport, Md., to Cherry Run, 14 miles.

224. *West Virginia & Pittsburg.*—Surveyed, Weston to Braxton, 30 miles.

225. *West Virginia & Pennsylvania.*—Surveyed, Rowlesburg to Fairchance, Pa., 50 miles. President, Thos. G. Hillhouse, New York City; Chief Engineer, C. E. Gallagher, Rowlesburg.

226. *West Virginia Central & Pittsburg.*—Track laid in 1889, Parsons to Elkins, 22 miles. Projected, Elkins to Charleston, 85 miles.

Projects and Surveys.

227. *Ohio & West Virginia Southern.*—Under survey Marietta to Braxton, 75 miles. President, T. W. Moore, Marietta, O.

228. *West Virginia & Kanawha.*—Surveyed, St. Albans up Coal River, 60 miles. Chas. A. Draper, 16 Exchange Place, New York City.

Total.—Track laid in 1889, 53.5 miles. In process of construction, 227.5 miles. Surveyed or under survey, 248 miles. Projects of some promise, 135 miles.

KENTUCKY.—Existing Roads.

Covington Transfer.—Partly graded, Covington to Ludlow, 2 miles.

229. *Eastern Kentucky.*—Track laid in 1889, Willard to Webville, 2 miles.

230. *Kentucky Midland.*—Track laid in 1889, Frankfort to Paris, 40 miles.

231. *Kentucky Union.*—Track laid in 1889, Dodge to Winchester, 6.75 miles; Clay City to Kentucky River, 30 miles. Track laid in 1890, Winchester towards Lexington, 10 miles. Graded, end of track to Lexington, 10 miles; Kentucky River to Jackson, 18 miles. Under contract, Jackson to Lost Creek, 10 miles.

Lexington Belt.—Under construction, at Lexington, 8 miles. President, Chas. H. Stoll, Chief Engineer; A. I. Totten, both of Lexington.

Louisville & Nashville.—Track laid in 1889, Pineville to Cumberland Gap, 14.7 miles.

232. *Louisville, Hardensburg & Western.*—Track laid in 1889, Irvington west, 20 miles. Track laid in 1890, Hardensburg to Fordsville, 13 miles. Graded, branch to Falls of Rough, 4.5 miles.

Louisville, St. Louis & Texas.—Projected, Victoria to Fordsville, 14 miles.

233. *Louisville Southern.*—Track laid in 1889, Lawrenceburg to Lexington, 24 miles. Richmond, Nicholasville, Irvine & Beattyville R. R.—Under construction, Versailles to Beattyville, 95 miles. Projected, Beattyville to Virginia State line, 85 miles.

234. *Ohio & Big Sandy.*—Surveyed, Richardson to Pocahontas, Va., 80 miles.

189. *Ohio Valley.*—Track laid in 1889, Indiana State line to Henderson, 7.3 miles.

235. *Owensboro, Falls of Rough & Green River.*—Track laid in 1889, Owensboro to Fordsville, 28 miles. Under construction, Fordsville to Falls of Rough, 10 miles.

Paducah, Tennessee & Alabama.—Surveyed, Paducah to Tennessee State line, 150 miles.

Passenger & Belt.—Track laid in 1889, at Lexington, Ky., 2.5 miles.

236 *West Virginia, Pineville & Tennessee.*—Under construction, Pineville, west, 10 miles. Projected 10-mile post to Breaks of Sandy, 130 miles. President, H. V. Loving, Pineville.

Projects and Surveys.

237. *Bowling Green & Northern.*—Surveyed, Bowling Green to Chesapeake & Ohio Southwestern R. R., 40 miles. Secretary, M. H. Crump, Bowling Green.

238. *Henderson State Line.*—Projected, Henderson to Bowling Green, 100 miles. President, S. K. Sneed, Henderson.

239. *Mount Sterling.*—Projected, Mount Sterling to North Middleton, 10 miles. M. S. Tyler, Mt. Sterling.

Total.—Track laid in 1889, 175.25 miles. Track laid since Jan. 1, 1890, 23 miles. In process of construction, 1675. miles. Surveyed or under survey, 270 miles. Projects of some promise, 339 miles.

The City of London & Southwark Electric Underground Railway.

[FROM AN ENGLISH CORRESPONDENT.]

The above railway, which has been in course of construction for about five years, is now approaching completion and will be in future known as the City & South London Ry. The line commences in King William St., near London Bridge, and terminates at Stockwell, a distance of about three miles; but the company is applying to Parliament this session for powers to extend the railway to Clapham, when the total length will be four miles. The line consists essentially of two iron tunnels, 10½ ft. in diameter. One of these tunnels was completed as far as Stockwell a short time ago, while the second will be finished in about a month. Great difficulty was experienced in driving the tunnels through the wet gravel, but these have been successfully overcome. There will be in all six stations, and of these, five are already finished. At each station, in addition to the staircases, there are being provided two large elevators, by means of which passengers will pass from the street level to that of the station below, and *vice versa*. The hydraulic machinery for actuating the elevators, is being fitted up Sir WILLIAM ARMSTRONG, and the erection of the electric light stations and the construction of the passenger carriages are now being carried out. Although the railway is to be worked by electricity, no decision has as yet been arrived at as to what system to employ. Two experimental electric locomotives have however been constructed by the electrical contractors, Messrs. Mather & Platt, and with these, many trial runs have been made on one portion of the railway. A speed of 20 miles an hour has been attained by one locomotive with three carriages attached, but the results obtained with the second are not considered satisfactory. At the Stockwell terminus the boiler, engine and dynamo houses have already been erected, and some of the machinery installed. It is proposed to run the trains at 15 miles an hour, and the time at present occupied in making the journey by omnibus will, by the construction of this railway, be reduced by at least three-quarters. If the railway can be successfully worked, and there does not seem at present to be any reason to think otherwise, it will be of great public benefit. It is intended to open the line during the coming summer.

PERSONALS.

MR. HENRY B. HURLEY has been appointed City Engineer of Nashua, N. H.

Col. B. R. SWOOPE has been reappointed Superintendent of the South Florida R. R.

Mr. W. M. SIMMONS has been appointed Secretary to President BREYFOGLE of the Louisville, New Albany & Chicago Ry., with an office at Chicago.

Mr. C. P. HUNTINGTON has been elected President of the Southern Pacific Co. Mr. C. F. CROCKER, Mr. H. N. TOWNE and Mr. J. C. STUBBS are Vice-Presidents.

MR. THOMAS FLESHER, JR., Superintendent of the Toledo Division, Lake Shore & Michigan Southern Ry., has resigned. His successor is Mr. J. M. WATTS.

MR. J. C. FERGUSON, C. E., and MR. J. C. CRAIG, architect, late of Denver, Col., have formed a partnership as consulting engineers and architects at Seattle, Wash.

M. HORACE LOOMIS, Commissioner of Street Cleaning, New York City, has resigned. Mr. HANS S. BEATTIE, ex-Surveyor of the port, has been appointed in his place.

EVI HEGE has been appointed General Manager of the Kentucky Union R. R. He was formerly Roadmaster on the Jeffersonville, Madison & Indianapolis R. R.

JAMES MCDONALD, manager of the Youngstown Bridge Works, formerly located at Mt. Vernon, O., has resigned to accept a responsible position with Oliver Bros. & Phillips, of Pittsburg, Pa.

MR. C. E. LINDSAY has been appointed Engineer of Maintenance of Way of the Pittsburg, Cincinnati & St. Louis Ry. (Little Miami Division), vice Mr. W. B. LEEDS, promoted. His office will be at Cincinnati, O.

MR. J. T. HARAHAN, late General Manager of the Chesapeake & Ohio Ry., has accepted the General Managership of the Louisville, New Orleans & Texas R. R. He will have his headquarters in Memphis, Tenn.

Mr. G. M. BEACH, who was made General Manager of the Chicago & Atlantic Ry. when it went into the hand of a receiver last year, has resigned. It is stated that the office is to be abolished.

Col. J. W. FRY, Superintendent of the Cape Fear & Yadkin Valley Ry., has been promoted to the position of General Manager of that line, and will have charge of the traffic, maintenance and operating department.

Sir JOHN FOWLER and Sir BENJAMIN BAKER had conferred upon them on March 27 the honorary freedom and livery of the Turners Company, of London. The ceremony took place at the Guild Hall, and Mr. W. BURDETT-COUTTS, M. P., the Master, presided.

Mr. FREDERIC PERCY BURT, of the editorial staff of ENGINEERING NEWS, was married on April 8 to Miss MATTIE E. WYCKOFF, of Montclair, N. J., the daughter of Mr. GEORGE H. WYCKOFF, Vice-President of the Garfield National Bank, of New York.

MR. GEORGE H. ELLERY, of New York, a member of the firm of Ellery, Wendt & Hoffbauer, railway contractors, died last week. He was at one time Vice-President of the Indianapolis & Evansville R. R. Co. (now the Evansville & Indianapolis).

Messrs. THOMAS DOLAN, HENRY G. GIBSON and A. A. MCLEOD, Vice-President and General Manager, were elected on April 9, directors of the Reading R. R., to succeed Messrs. GEO. F. BAER, STEPHEN A. CALDWELL and SAMUEL SHIPLEY, resigned.

CORRECTION.—In the note in our last issue on the Kentucky Geological Survey, Dr. D. D. OWEN was mentioned as the Chief Assistant of the survey. Dr. OWEN was the the original State Geologist some years ago. Mr. A. R. CRANDALL more nearly fills the place mentioned than any other one man.

Mr. HENRY FLAD, Past President of the American Society of Civil Engineers, was appointed on April 5, by the President of the United States, a member of the Mississippi River Commission, to succeed Mr. S. W. FERGUSON, who retires. The appointment is received as an exceedingly happy one.

MR. NEWMAN ERB has been appointed receiver of the Kansas City, Wyandotte & Northwestern and Kansas City & Beatrice railways and their branches by Judge HENRY C. CALDWELL of the United States Circuit Court

at Kansas City. Mr. ERB has qualified as a receiver and given notice that he has taken possession of the roads, branches, equipment, etc. Until otherwise ordered the heads of departments will be retained in their respective positions.

MR. W. R. WOODARD having tendered his resignation as Superintendent of the Louisville, New Albany & Chicago Ry., General Manager BLACK has issued a circular stating that Mr. JOHN EWAN, Superintendent o Transportation, will perform the duties of Superintendent. Mr. EWAN was formerly Superintendent of the Indianapolis division of the Bee Line (C., C., C. & I. Ry. now the Cleveland, Cincinnati, Chicago & St. Louis R. R.)

Sir BENJAMIN BAKER, according to a vague London rumor, is to be called in as consulting engineer for the proposed Hudson River suspension bridge at New York. It is rather early yet to talk of consulting engineers to this structure; and with all due respect to the genius and experience of Sir BENJAMIN BAKER, it is altogether probable that this country can provide all the engineering talent required on a structure so diametrically differing from the plan and detail of the Forth bridge.

MR. WILLIAM GALLOWAY, said to have been the first locomotive engine driver in this country, died at Baltimore, Md., April 7, at the age of 81. He had been connected with the Baltimore & Ohio R. R. for 54 years. Before the locomotives appeared, and when the cars were drawn by horses, Mr. GALLOWAY became the car dispatcher at Mount Clare Station. When the Baltimore & Ohio completed its tracks to Washington, Mr. GALLOWAY was put in charge of Lafayette Engine No. 13, and he ran between the two cities for 46 years. In all his service he met with but two accidents, in both of which his engine was thrown from the track. In 1887 he was retired with a pension.

Mr. ALEXANDER CRAWFORD, the pioneer iron manufacturer of the Mahoning Valley, died last week. He built a rolling mill in New Castle, Pa., in 1839, and was the first to use coal in his blast furnaces at Lowellville. He was instrumental in organizing the New Castle Beaver Valley R. R. Co. in 1860, and was its President until he died, and also a director, and was largely interested in the construction of the Erie & Pittsburg R. R. He founded the Wabash Iron Co. of Terre Haute, Ind., now managed by his son. He was President of the St. Louis, Salem & Little Rock R. R., having been interested in its construction, and was General Manager of the Nashville & Knoxville R R.

PUBLICATIONS RECEIVED.

—*Annual Report of the Railroad Commissioner of Rhode Island for* 1889. 8 x 5 ins., 98 pp., cloth bound. E. L. FREEMAN, Commissioner.

—*Tenth Annual Report of the State Board of Health of South Carolina*, for the fiscal year ending Oct. 31, 1889 Pamphlet, 65 pp. H. D. FRASER, Secretary.

—*Report of the Water Board, Leominster, Mass.* 1889–90. Pamphlet, 12 pp. HAMILTON MAYO, Chairman.

A summary is given of the numbers of each class of water takers.

—*Reports of the Finance Committee, Treasurer, Engineer, etc., of the City of Dubuque (Ia.)* 1890. Pamphlet, 47 pp. M. TSCHIRGI, Jr., City Engineer.

The City Engineer's report contains some observations on streets and street cleaning, and mentions the separate system of sewerage recently built.

—*Fifteenth Annual Report of the Board of Water Commissioners of the City of Atlanta, for the year* 1889. Pamphlet. 13 pp. W. P. RICHARDS, Superintendent.

The whole of the regular supply was filtered in 1889, the Hyatt filters working satisfactorily. The total amount of alum used in the filters was 79,032 lbs., or 3-5 of a grain to each gallon of water.

—*Eighth Biennial Report of the State Board of Health of Maryland, for the two years ending Dec.* 31, 1889. Cloth, 6x9 ins. 287 pp. J. W. CHANCELLOR, Secretary.

A small part of the volume is given to the consideration of pure water, including a discussion of the methods for the purification of drinking water. Other questions, not so interesting to the majority of readers, are more fully treated.

—*Seventeenth Annual Report of the Water Commissioners of the City of Hudson (N. Y.) for the year ending Sept.* 30, 1889. Pamphlet, 27 pp. JNO. S. RAY, Superintendent.

The Commissioners mention favorably the "free system" in vogue, in accordance with which, as near as can be gathered from the report, there are no direct charges to consumers for water; or in other words, the current expenses of the works are met by direct taxation. An objection to the system is the greater tendency to an excessive use of water.

—*Annual reports of the Committee on Water, the Water Commissioner, the Water Registrar and the City Engineer of the city of Worcester for the year ending Nov.* 30, 1889. Pamphlet, 26 pp. JNO. G. BRADY, Commissioner; GEO. E. BATCHELDER, Registrar.

The report refers to the condition of the meters, of which it is thought that from 1,000 to 1,500 do not register more than one-half of the water passing through them. The registrar recommends that the city repair the meter without expense to the owner.

—*City of Cambridge (Mass.). Annual Report of the City Engineer to the City Council for the year ending Nov.* 30, 1889. Pamphlet, 20 pp. L. M. HASTINGS, City Engineer.

Regarding sewers, the report states that 2.8 miles were added during the year, making a total length of 83.8 miles. A tabular description of the new sewers is given, including for each line material used, size, average depth of cut, number of manholes, lamp poles, inlets, length and cost.

Annual Reports, City of Nashville, Tenn. 1889. Pamphlet, 118 pp. J. A. JOWETT, City Engineer; GEO. REYER, Superintendent of Water-Works.

This pamphlet contains the reports of all the city departments. Among the tables may be mentioned one showing the disbursements by months and for the year as distributed in the 21 accounts. The largest disbursements were made by the water-works department, $348,469; interest on bonds, streets and sewers are next. The statistics of each department seem quite complete.

—*Fifth Annual Report of the Board of Public Works to the Common Council of the City of East Saginaw (Mich.)* Pamphlet, 69 pp. City Engineer, R. W. ROBERTS.

The most valuable matter in this report seems to be that given in tables at the end. These include very complete and detailed statistics regarding sewers constructed in 1889, describing the sewers and giving the various items of the cost of each line; sewers constructed to date, with cost to adjoining property, to city, and total cost; streets paved to date, giving width of street and material used.

—*The Thirty-Sixth Annual Report of the Board of Water Commissioners of the City of Hartford (Conn.) to the Court of the Common Council, for the year ending Mar.* 1, 1890. Pamphlet, 31 pp. EZRA CLARK, President.

This report contains a legal opinion by three men on several points, regarding the powers of the Commissioners. Though the points involved are local, yet the opinion has considerable general interest. An appendix contains many valuable statistics, as: "Summary of receipts for water rents in 1889, showing the number of each class of consumers, the total rental from the class, and the increase or decrease over 1888; statement of receipts and current expenses, by years, from 1856 to 1889, inclusive; the distribution of cost to the various departments, 1857 to 1889; and tables of rainfall, by months and years from 1875 to 1889.

SOCIETY PROCEEDINGS.

Liverpool Engineering Society.—The eleventh ordinary meeting of this Society was held March 12th at the Royal Institution, Colquitt street, Liverpool, England, the President, Mr. Henry H. West, M. Inst. C. E., in the chair.

Mr. Charles H. Yeaman gave a *résumé* of his paper, entitled "Notes on Central Station Electric Lighting," which was read before the Society on Jan. 29, and a long and interesting discussion took place upon the same. Mr. Yeaman replied to the various points raised during the discussion.

Engineers' Club of St. Louis.—Meeting April 2, 1890. The club met at the Washington University, President Nipher in the chair; 35 members and 8 visitors present. Mr. Thos. Long addressed the club informally on the erection of some recent large bridges. The address was illustrated by lantern slides, showing interesting features of the prominent bridges discussed. A number of slides were devoted to the St. Louis Merchants' bridge, just completed. The last span of this bridge was erected in less than 69 working hours, being the shortest time on record for a double track bridge. The large bridge recently erected across the Ohio River at Cairo was described. A span of this bridge was erected in 45 working hours, being the shortest reported time for a single track structure. Among the other bridges described by the author were those at Hawkesbury, Australia; C. Shaler Smith's cantilever bridge over the Kentucky River; the Niagara cantilever bridge; another cantilever bridge over the Kentucky river; the Hudson River bridge at Poughkeepsie; the Forth and Tay bridges, the specially interesting features of each being explained. The club expressed its appreciation of the address by applause.

Mr. Frank Nicholson's paper on "The Pemberton Concentrator" was then read by Mr. Arthur Thacher. The author explained the difficulties met with in concentration, and stated that there was a widespread opinion that concentration under any circumstances was of doubtful value. The writer explained the Pemberton concentrator, which was of new design, and appeared to have advantages in simplicity and requiring no power. In the discussion, Mr. Wheeler took issue with the author on the subject of the efficiency of concentrators. He stated that a large number were in regular and successful operation, and cited instances bearing out his statement. Many low grade ores were being profitably handled with concentrators which could not be worked at all without them. He considered the Pemberton apparatus, strictly speaking, a hydraulic classifier, and not a concentrator. He also stated that in general the fine material should not be sized. He thought the Pemberton apparatus would save water, and that it also had some other points of merit, but it was in many other respects inferior to the latest types of concentrators. Mr. Thacher thought the author, in stating his opinion as to the efficiency of concentrators, had reference principally to stamp mills, and did not have reference to the Eastern mills. He also called attention to the fact that the profit claimed to be realized by this concentrator would probably be largely reduced by other necessary expenses in working up the ore. Adjourned.

WM. H. BRYAN, Secretary.

Master Car Builders' Association.—The following named railroad companies have become parties to the Rules of Interchange, as prescribed in Rule No. 28, since the last revised Code of Rules was published: Alabama & Vicksburg, Atlanta & West Point, Canadian Pacific-Cincinnati, Hamilton & Dayton, Cincinnati, Selma & Mobile, Des Moines & Northern, Duluth & Iron Range, Grand Rapids & Indiana, Huntington & Broad Top Mountain, Jacksonville, Tampa & Key West, Kanawha & Ohio, Missouri, Kansas & Texas, Montana Union, Newport News & Mississippi Valley, Pittsburg & Western-St. Louis, Arkansas & Texas, St. Louis, Keokuk & Northwestern, Toledo, St. Louis & Kansas City, Western Railway of Alabama.

In several instances roads in this list have been adhering to the Rules of Interchange for two or three years, but their names have not appeared in the list at end of Interchange Rules, owing to a misunderstanding and a belief on the part of some representative members that the appointment of such a representative by their several companies implied an adhesion to the Rules of Interchange, which is not the case. The Rules of Interchange are binding upon those who share their benefits, while all other actions of the Association have only a recommendatory character, therefore the list of roads at the end of the Code of Rules embraces only such railroad companies as have given specific notice to the Secretary that they wish to become parties to the Rules of Interchange, as provided in Rule No. 28 of the revision of 1889, and by a similar rule in earlier revisions.

All interested parties are requested to see that proper advices are given to the Secretary if any railroad companies desire to have their names added to this list.

JNO. W. CLOUD, Secretary.

BUFFALO, N. Y., April 4, 1890.

General Railroad Time Conference.—The semi-annual meeting was held at the Hotel Brunswick, New York City, April 9. The report of the Executive Committee showed a membership of 172 railways operating 124,000 miles of road. Eighty-six companies were represented at the meeting.

Mr. H. S. Haines, President of the organization, in his address spoke of the relations which existed between the railway companies and the labor organizations, which controlled a greater number of their employés. He compared the discipline necessarily preserved in the great railway companies to that of an army, and declared that as the railway system increased this discipline would have to be more rigid. He thought that a spirit of resistance to restraint and reproof, a mutinous tendency, and a disposition to oppose the interests of the company in matters indifferent to the employés, were encouraged by the labor unions. He spoke of the necessity of weeding out the inefficient in all branches of employment, and suggested that the absorption of outsiders into the railway ranks should cease, and after all questions of wages should have been adjusted by arbitration, or the law of supply and demand, he considered it was then time to determine the relations between employer and employé, so as to secure the best interests of both. In regard to the Interstate Commerce law he said:

"The determination on the part of politicians to insure competition has but proved the truth of Stephenson's assertion that where competition is possible combination is probable: the promotion of pools has hastened the absorption of the weaker by the stronger corporations, and the time is approaching when one of two solutions of the railroad transportation problem must be attempted—either a government management or a territorial division among private corporations.

The Committee on the Standard Code of Train Rules said that the code was now used by 93 companies, operating 65,734 miles of road, an increase of 14 roads, operating 13,467 miles, since the October meeting. The Car Service Committee requested that definite action should not be taken by the convention until the meeting next autumn upon the committee's previous recommendations. They were to the effect that instead of the railroad companies paying three-quarters of a cent a mile while using cars they should substitute a rate of 10 cents a day whether the cars are in use or not, and when the cars are in use should add a rate of one-half of a cent a mile. The convention will decide upon this important matter at its next meeting, which will be held Oct. 8.

The following officers were elected: President, H. S Haines; First Vice-President, James McCrea; Second Vice-President, H. F. Royce; and Secretary, W. F. Allen. The Executive Committee is as follows: H. Stanley Goodwin and J. G. Metcalf. The members of the Committee on the Code of Standard Train Rules are J. T. Harahan and H. Walters.

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CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER
ASSOCIATE EDITORS.
GEO. H. FROST.....BUSINESS MANAGER

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Engineers' Club of Kansas City, Mo.—Next meeting, April 14. "Bridge Substructures in the Kansas River," E. I. Farnsworth. "Drawbridges as Closed by Water Power," and "River Motors in Europe," S. N. Stewart. Secy., Kenneth Allen, 200 Baird Building.

Western Railway Club, Chicago, Ill.—Next meeting, April 15. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, April 15. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, April 16. Secy., S. E. Tinkham, City Hall.

Engineers' Club of St. Louis, Mo.—Next meeting, April 16. "Railway Inclines," I. A. Smith; "The Reproduction of Drawings," D. C. Humphreys. Secy., W. H. Bryan, 309 So. 7th St.

American Society of Civil Engineers, New York.—Next meeting, April 16. Secy., John Bogart, 127 E. 23d St.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, April 17. Secy., Clement March.

New York Railway Club.—Next meeting, April 17. Rooms, at 118 Liberty St.

Engineers' Club of Philadelphia, Pa.—Next meeting, April 19. Secy., Howard Murphy, 1122 Girard St.

Western Society of Engineers, Chicago, Ill.—Next meeting, May 1. Secy., J. W. Weston, 230 La Salle St.

Association of Civil Engineers, Dallas, Tex. Next meeting, May 2. Secy., E. K. Smoot, Elm and Austin Sts.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, May 5. Secy., Geo. L. Wilson, City Hall.

Civil Engineers' Club, Cleveland, O.—Next meeting, May 6. Secy., C. O. Palmer, 22 Cedar Ave.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, May 8. Secy., Olin H. Landreth, Vanderbilt University.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, May 14. Secy., J. C. Herring, Wichita.

New England Railway Club, Boston Mass.—Next meeting, May 14. Secy., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

American Water-Works Association.—Annual meeting at Chicago, Ill., May 20. Secy., J. M. Diven, Elmira, N. Y.

Master Car-Builders' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 10. Sec., J. W. Cloud, Buffalo, N. Y.

American Railway Master Mechanics' Association.—Annual convention in June. Sec., Angus Sinclair, 140 Nassau St., New York.

We are glad to learn that the bill as to safety appliances introduced by ex-Commissioner L. S. COFFIN has been passed by the Iowa Legislature, and now awaits the signature of the Governor, which it will undoubtedly receive. The bill provides that all new or "generally repaired" cars must have automatic couplers applied, and by Jan. 1, 1895, all other cars must be so equipped. By Jan. 1, 1892, all engines must have driver brakes; by Jan. 1, 1893, no trains shall be run which the engineer cannot control by power brakes (not necessarily on all cars, we infer, but on a sufficient number to control the train), but the home roads are allowed to haul foreign cars not so equipped with brakes and couplers, regardless of these dates, as is but just. We see no great hardship in these conditions, except perhaps that five years is a rather short period for equipping the entire stock with automatic couplers. It is for the railway's own interest, however, that this should be done, inasmuch as the law also compels thorough equipment of the stock with automatic brakes, and the two together will lead to great operating economies discussed in detail in our issue of Dec. 21, 1889. This will soon be so apparent that there is not likely to be any great opposition or sense of hardship. There is no longer room for intelligent dispute that a good, serviceable type of train brakes and automatic couplers has been developed, not likely to be soon, if ever, materially improved upon, unless in minor details and processes of manufacture, and equal to all reasonable requirements. This being so, it is well that legislation should be had compelling the roads which might otherwise lag behind to do what the more progressive roads will do and are doing anyway. The proposed bill does not seem to do more than this.

THE report noted elsewhere that the control of the Union Pacific Railway is likely to pass into the hands of the VANDERBILTS at the next election, now close at hand, may or may not be true, but it has been reported as a probability for so long that there is quite likely to be something in it. It is also said that the Alton is passing into the same control, and it is certain that one road after another must continue to do so unless there is some great change in existing conditions or the VANDERBILT investments are deflected into some other channel than that of railway property. When a fortune becomes so great that all that its owners can spend out of its income does not materially decrease that income, there is but one end possible: it must either be wasted in speculation or in silly investments, or given away, or go on increasing in compound ratio until it finally becomes so colossal as to be of national moment. The VANDERBILTS give away nothing to speak of in comparison with their fortune, although they have recently done some creditable things. Neither do they speculate seriously; neither do they make silly investments, as yet, to any sensible extent. Until they divert their investments from railways altogether, consequently, their railway control must continue to expand; a thing which might not be regrettable if they showed the liberality of management which they could so well afford; but unfortunately they do not, although there has been improvement of late years. How little difference it makes in the final result what rate of interest is received is evident from the fact that a property doubles in 23 years at 3 per cent., in 18 years at 4 per cent., in 14 years at 5 per cent., in 12 years at 6 per cent. and in only 9 years at 8 per cent. If the present holdings of the Vanderbilt family be $300,000,000, they will be $1,320,000,000 in 50 years even at 3 per cent. and over twice that at 4½ per cent. In either case it is only a question of a few decades more or less when they may solve the Nationalist problem raised by BELLAMY by owning the whole country.

THE rapid transit problem will not down at any one's bidding, and the latest move in it, and one of the most hopeful, is the appointment by Mayor GRANT of a Board of five Commissioners of an unusually high character, consisting of AUG. BELMONT, banker; JOHN H. STARIN, steamboat man; CHAS. STEWART SMITH, President of the Chamber of Commerce; WM. STEINWAY, of the great piano firm and ORLANDO B. POTTER, M. C., a great real estate owner. The Board are all very wealthy men, and are known more or less, also, as public-spirited citizens. None of them are known (to us at least) to have any private axes to grind which would interfere with a proper discharge of their semi-judicial duties. None of them are known or believed to have had any suspicion that they were to be appointed, still less to have sought the appointment. By the law of 1875, under which they are appointed, they have very considerable powers, and we earnestly hope they will be wisely exercised. The necessity is a pressing one for some means of true rapid transit by which the journey from the Harlem River to Twenty-third Street, at least, can be made at a rapid rate, with few or no stops. This secured, immense development will quite certainly take place in the "annexed" district, and Westchester Co. generally, which is the most desirable suburban residence section anywhere around New York except for this difficulty of rapid transit.

IN answer to numerous queries, we would say that the copies of the Forth Bridge issue of *Engineering*, ordered by us for our correspondents, have been shipped from London, but have not yet been received by us. As soon as they arrive they will be promptly mailed to those who have sent in orders. We make this announcement to satisfy some of our correspondents who are becoming a little impatient. The first London edition was exhausted when our order was cabled; but we have received notice that our order has been filed and the books shipped.

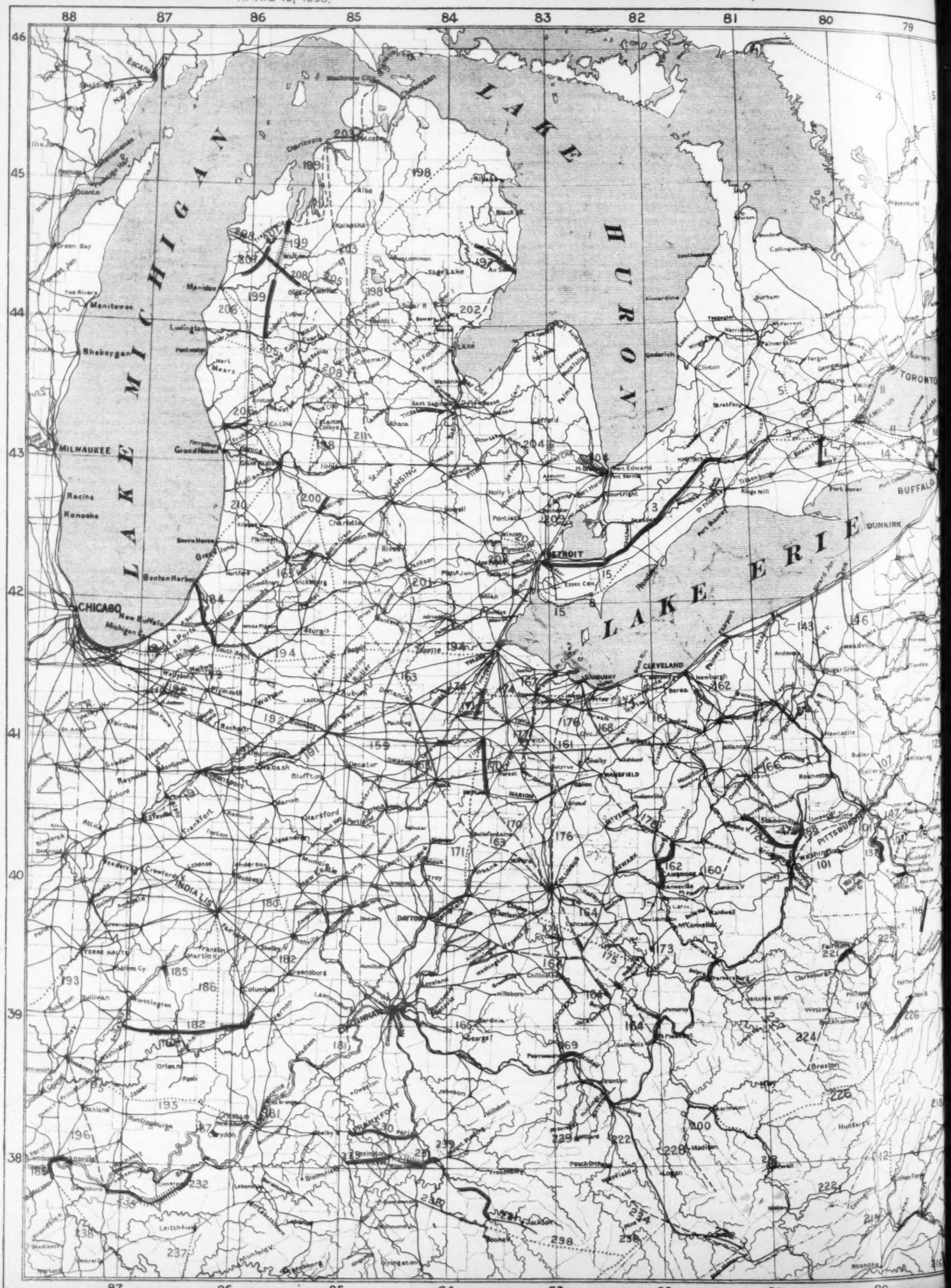
Railway Construction in the States East of Chicago.

The map and list of new railway enterprises located in the States east of Chicago, which we present this week, shows that the work of railway construction and survey in this section is fully as active as last year. The total new construction of the year in these States will probably exceed 1,000 miles.

In connection with our last preceding map of this section, published a year ago, attention was called to the fact that construction was then more active in this section than in 1887, when the greatest total construction was recorded. The records of the year's work amply verified this prediction, about 1,150 miles of railway being built in these States (excluding the North Michigan Peninsula) in 1889 against about 900 miles in 1887. It now seems certain that work in this section will be on the whole at least as active this year as last and it is very likely that last year's record may be considerably exceeded. The number of miles of each class of work under way last year and now is as follows:

	Track laid since Jan. 1.	In process of construction.	Surveyed or under survey.	Projects of some promise.
Mar. 30, '89..	73	1,677	3,362	3,020
Apr. 12, '90..	49	1,309	3,519	3,147

While the above figures seem to show about 370 miles more under construction a year ago than now, the fact that about 160 miles of this work is double track, and that a considerable proportion of the single track lines have very heavy work, makes it probable that at least as much construction work is in progress in these States now as a year ago, while more lines on the whole are being surveyed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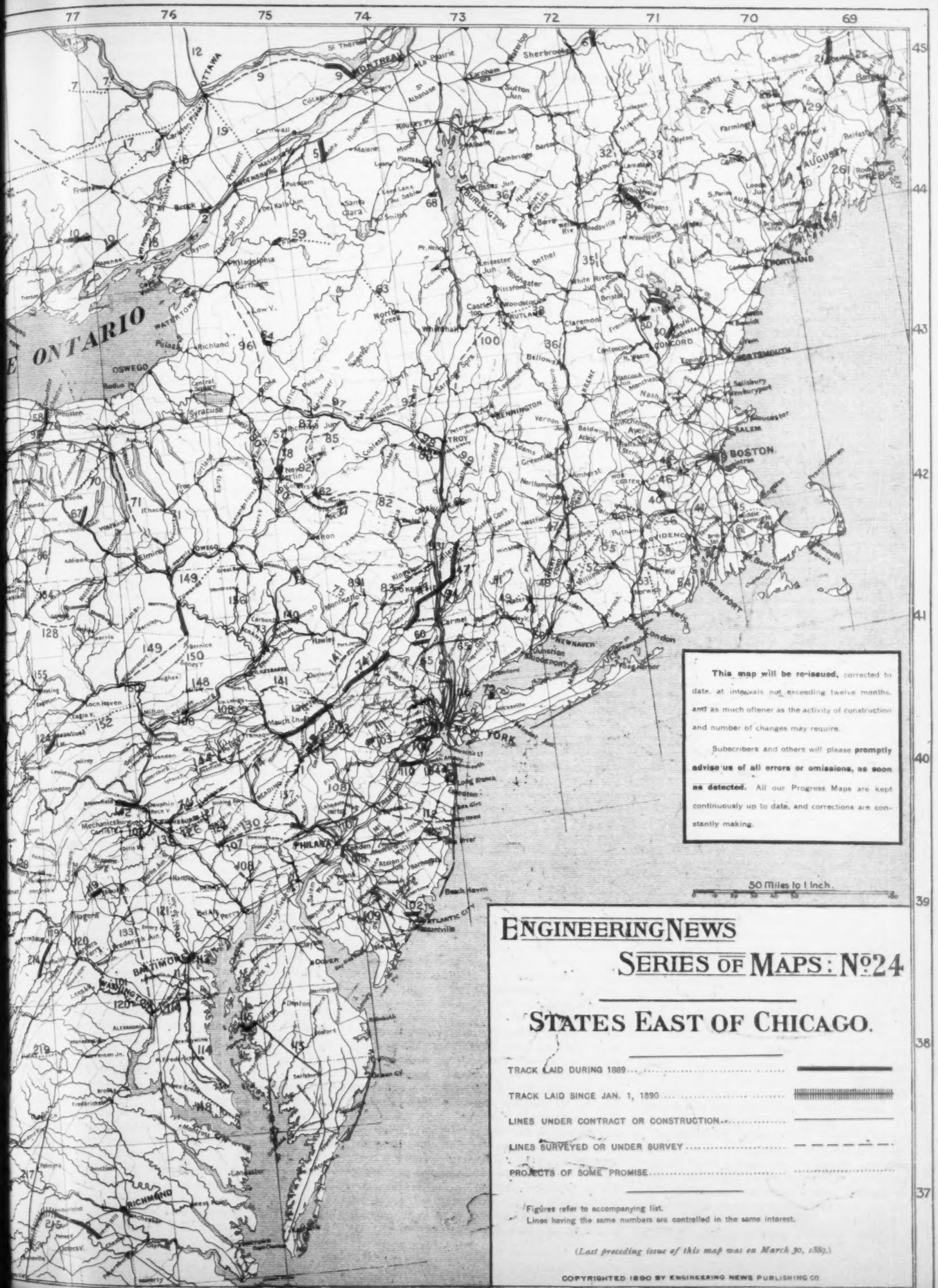

This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.

Subscribers and others will please **promptly advise us of all errors or omissions, as soon as detected.** All our Progress Maps are kept continuously up to date, and corrections are constantly making.

ENGINEERING NEWS
SERIES OF MAPS: No. 24

STATES EAST OF CHICAGO.

TRACK LAID DURING 1889.....

TRACK LAID SINCE JAN. 1, 1890.....

LINES UNDER CONTRACT OR CONSTRUCTION.....

LINES SURVEYED OR UNDER SURVEY.....

PROJECTS OF SOME PROMISE.....

Figures refer to accompanying list.
Lines having the same numbers are controlled in the same interest.

(Last preceding issue of this map was on March 30, 1889.)

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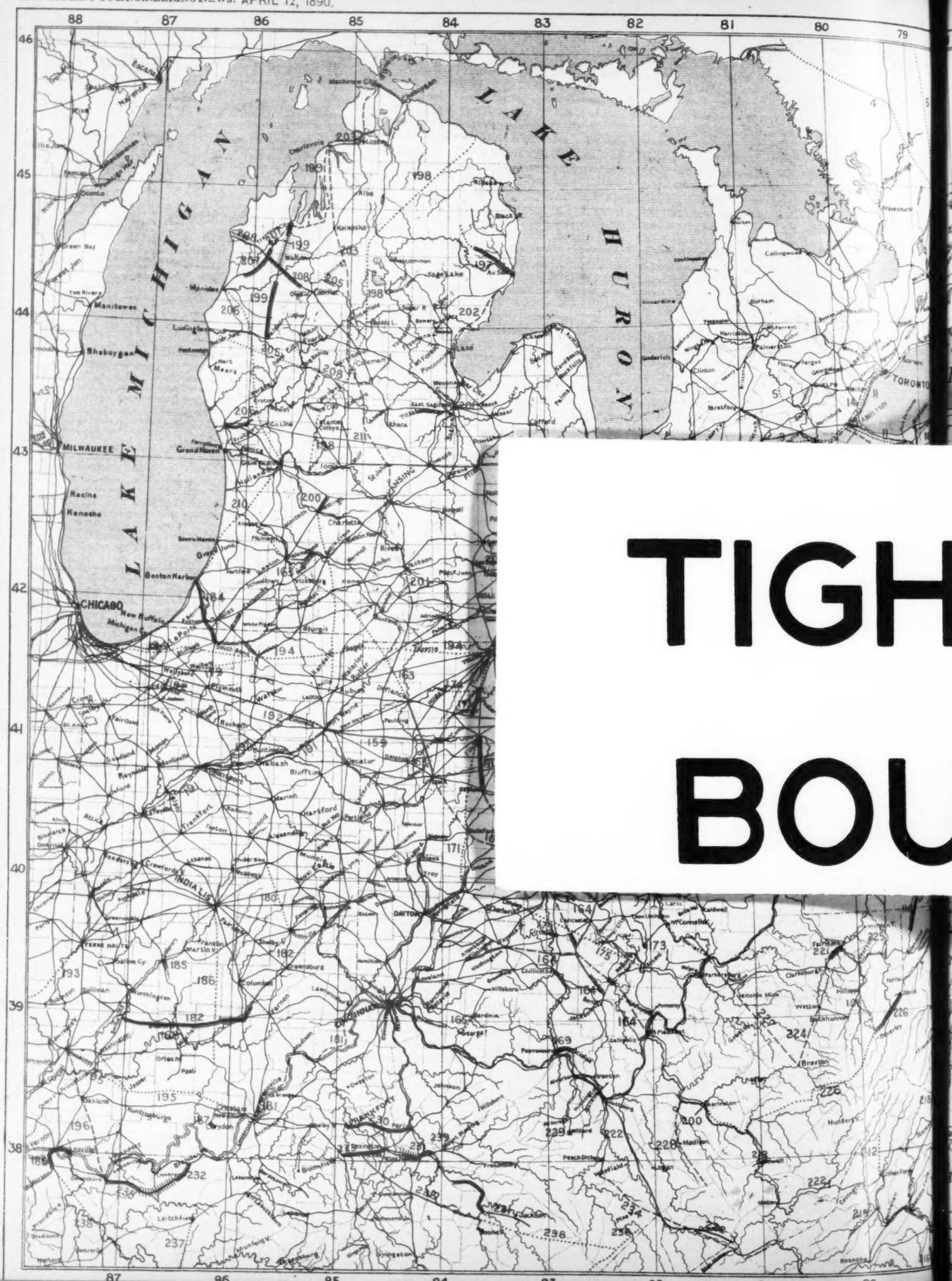
LAKE MICHIGAN
LAKE HURON
MILWAUKEE
CHICAGO
INDIANAPOLIS
DAYTON
TORONTO
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This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.

Subscribers and others will please **promptly advise us of all errors or omissions, as soon as detected.** All our Progress Maps are kept continuously up to date, and corrections are constantly making.

50 Miles to 1 Inch.

ENGINEERING NEWS
SERIES OF MAPS: No. 24

STATES EAST OF CHICAGO.

TRACK LAID DURING 1889

TRACK LAID SINCE JAN. 1, 1890

LINES UNDER CONTRACT OR CONSTRUCTION

LINES SURVEYED OR UNDER SURVEY

PROJECTS OF SOME PROMISE

Figures refer to accompanying list.
Lines having the same numbers are controlled in the same interest.

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and projected with reasonable prospects of early construction.

The summary of the mileage in various stages in each State is given in the following table:

States.	Track laid.		Under contract or construction.	Located and under survey.	Projects of some promise.
	In 1889.	To date in 1890.			
Maine	19.78	.....	13	367	95
N. H.	45 85	.....	.....	27	60
Vt.	.....	.....	.....	87	30
Mass.	8.45	0.2	14	54	86
Conn.	5.63	.....	.....	36	116
R. I.	.....	.....	8	.....	32
N. Y.	135.33	3	234	670	184
N. J.	58.91	4	74	89	33
Del.	0.2	.....	.....	.....	.....
Md.	20.55	.....	138	101	271
Pa.	202 24	3	335	558	330
Ohio.	125.63	.....	335	621	418
Ind.	125 15	.....	96	279	800
Mich.	200.37	30	62	630	632
Total.	1148.09	40.2	1309	3519	3147

In the three Southern States included within the limits of our map, the mileage proposed and under way is as follows:

States.	Track laid.		Under contract or construction.	Located or under survey.	Projects of some promise.
	In 1889.	To date in 1890.			
Va.	214.7	74.2	220	187	310
W. Va.	53.5	.....	228	248	135
Ky.	175.25	23	168	270	339
Total.	443.45	97.2	616	705	784

In Canada the summary of our list shows 495 miles of track laid in 1889, 10 miles laid since the beginning of the year, 297 miles under construction, 1,253 miles under survey and 1,932 miles of promising projects. A year ago our records showed 941 miles under construction, 437 miles under survey, and 1,046 miles of projects. Thus while the mileage under construction in Canada now is less than one-third that of a year ago, the mileage surveyed and projected is double and treble that of a year ago. The outlook in Canada, therefore, is more promising for work a year hence than for the coming season.

The most important line shown upon our map, and the most important one built east of Chicago since the completion of the West Shore, in 1885, is the Lehigh Valley's double track extension from Van Ettenville, N. Y., to Buffalo, 155 miles in length. This line, of which two-thirds is now under contract, will be built in the most substantial manner, and the necessary expenditure will probably equal that required to construct double the mileage of single track road of average cost. It will require two seasons to complete the road ready for traffic, and by that time, doubtless, the Lehigh Valley's New York terminals will be in such a condition that the company can handle through freight and passenger traffic between New York and Buffalo in competition with any of its many rivals. The chief mission of the extension, however, is to give the Lehigh Valley company its own outlet to Buffalo for the product of the Wyoming coal fields.

Another important line, also built principally for coal traffic, is the Pennsylvania, Poughkeepsie & Boston and Central New England & Western, or Poughkeepsie Bridge route, on which 113 miles of track were laid last year and over which trains are now running from Slatington, Pa., to Hartford, Ct., 240 miles. The work planned for the coming season is an extension to Harrisburg, surveys on which are practically completed. Another important extension in the hard coal district is the New York, Ontario & Western's 50-mile extension to Scranton, Pa. Tracklaying on this line has begun, and the road will probably be ready for traffic by fall.

Besides the double track construction of the Lehigh Valley Co., just noted, the Pennsylvania is constructing a 50-mile double track cut-off for through freight trains, running from Morrisville, Pa., to Downingtown, and saving some distance as well as the run through the city of Philadelphia. It is striking evidence of the enormous traffic of the Pennsylvania Railroad that it can afford to build a 50-mile double track railway simply to save delays to its through freight and relieve its crowded sidings in Philadelphia.

It will be seen from the above that the State of Pennsylvania not only has a large mileage of railway enterprises under way, but that the enterprises within her borders include some of the most important in the East. As our table shows, however, the State of Ohio has as many miles under construction and even a larger mileage under survey and projected.

An enterprise in Ohio whose prospects are of considerable interest, is the Cleveland, Akron & Western, now being graded from Akron west to Carey. It is within the limits of possibility that the construction of this line may have some effect on the fortunes of the Baltimore & Ohio. From Pittsburg to Baltimore, the line of the Baltimore & Ohio is one of the easiest of any that cross the Alleghenies. It follows the valleys of the Youghiogheney and Potomac rivers nearly all the way, and for eastbound traffic especially, the grades are very easy. It is probable that the Baltimore & Ohio could bring its through traffic from the West more cheaply over this route than over its main line through West Virginia. At present, however, the Baltimore & Ohio system has no line reaching Pittsburg from the West. The Pittsburg & Western, which is operated in harmony with the Baltimore & Ohio, reaches from Pittsburg to Akron. Surveys have been made for a short cut-off on this road and several minor changes of alignment, which will remove all its present heavy grades and make it an excellent line for freight transport. The new line from Akron west will connect with the Chicago line of the Baltimore & Ohio near Chicago Junction, and will thus afford the B. & O. a direct through line, with easy grades, from Chicago to Pittsburg. How cheaply the B. & O. can handle freight by this route remains to be seen; but it seems pretty certain that it can be handled at a less cost per ton-mile than by its present main line.

We have before referred to the graphic manner in which our maps show the prospective growth of the railway centers. The present map seems to indicate that the city of Columbus, O., is likely to become the most important railroad center in Ohio. Twelve railway lines already lead to it, and our map shows three lines surveyed to the north and west and one to the south. The Columbus, Lima & Milwaukee Ry., running northwest from Columbus, seems to be pushed with much energy. Forty miles of the line is now under construction, and it is expected that the division between Lima and Milwaukee, 80 miles, will be put under contract this season.

There are several lines projected to run across northern Ohio and Indiana, with Chicago as their objective terminus, some few of which are shown upon the map. The one of these which has attracted most public attention is the rather grandiloquently named American Midland. Of this road 22 miles have been completed, and the grading is finished 50 miles further west to Fort Wayne, Ind. It is possible that this line may be completed to form a western connection for the Cleveland, Akron & Western road, noted above.

In southern Indiana, the long extension of the Mackey system from Switz City to Richmond is the only extension of importance under way, and this will be completed this year. In Michigan considerable work is under way and planned, almost all in the timber districts, however.

In Canada the chief interest centers in the various lines proposed from Toronto to Niagara Falls. There is little doubt that by some route or other the Canadian Pacific will be extended to the latter point before many months.

A large proportion of the work in Canada is in the eastern provinces beyond the limits of our map. We hope to publish a special map of this section shortly showing these various lines. A scheme which has received considerable attention in the newspapers and which is noted in our list, though north of the limits of our map, is the proposal to build a railway from Sault Ste. Marie to Hudson Bay. It is hardly likely that trains will run over it this season.

In the South our map and list show the enterprises in Virginia, West Virginia and Kentucky. Doubtless, the most important line in these States is the extension of the Norfolk & Western system to Ironton, O., nearly 200 miles, contracts for which were let a few weeks ago. The chief purpose of this road of course is to give an outlet for West Virginia coal, coke and iron to the markets of Ohio and the West. It may be predicted that the road will not stop at Ironton. It would hardly pay to bridge the Ohio River merely to reach that point. Eventually the line will doubtless be continued to reach some principal railroad center where direct connections can be had with some of the large systems.

In central West Virginia the Baltimore & Ohio is at the back of several lines now being pushed with the object of developing the rich mineral and timber resources of that part of the State. The untouched mineral wealth of West Virginia is probably as great as that of any State in the Union. The Baltimore & Ohio is in a more advantageous position for developing these resources and securing a heavy and profitable traffic thereby than any other great company. It has moved so slowly in the matter, however, that it will now have to divide the traffic with other companies.

In Virginia also the principal enterprises shown on our map have the development of mineral lands as their chief object. The line of the Farmville & Powhatan, on which 34 miles of track was laid last year, has been completed since Jan. 1. The important work of the Norfolk & Western and the Atlantic & Danville in the southern portion of the State is just beyond the limits of our map, but will be shown on our map of the Southern States.

In central Kentucky, where work was very active last year, some construction is still in progress, but it is probable that the record of the year's construction will not reach that of 1889.

The Kentucky Union and the Louisville Southern are both pushing on into the mountains of eastern Kentucky, and seem to have strong backing. Farther west is the loop line of the Owensboro, Falls of Rough and Green River road, which has been completed since the beginning of the year.

It is a matter for congratulation that while work continues very active, a very large proportion of the enterprises are planned for the development of mineral or timber districts, and will, therefore, help rather than injure existing railways. Many of these enterprises, of course, are at the same time intended to compete with existing lines, but the number of enterprises upon our map whose sole purpose is to parallel existing roads is very small, and hardly any of them have advanced beyond the stage of preliminary survey.

The disastrous failure of the West Shore and Nickel Plate enterprises in 1885 has not been without fruit. It taught investors and the general public that money invested in paralleling roads able to carry the traffic is more likely to be productive of assessments than dividends and not improbably may be lost altogether. The failure of many smaller enterprises which have depended

too much on the prospects of taking business from established rivals teaches the same lesson every year to a few victims, though others are slow to take warning. Nevertheless, by looking back to the character of the enterprises of former years it is possible to see improvement in this respect.

The connection between overbuilding of unprofitable railways and financial crises is now well understood. Railways which develop new industries and resources and prove profitable to their owners, however, help toward the general prosperity of the country. It is fortunate that so large a proportion of the enterprises shown upon our map belong to the latter class.

American vs. Foreign Engineering Practice.

In a late editorial on English and American engineering practice we fear our contemporary, the *Engineering and Mining Journal*, fails to do full justice to American practice in the line of mechanicul perfection in our machines and their products. The Forth Bridge edition of *Engineering* is taken as a text, and we fully agree with all that is said in praise of that exhibit of our enterprising English contemporary. But we are not prepared to admit that a study of the contents of that special issue is calculated to make an American engineer "lose any conceit that he may have had as to the universal superiority of American practice in engines, machinery and construction work generally;" nor will we admit that the visit, last year, of American engineers to Europe had any tendency to decrease the "conceit" of those who really understood machine tools and their construction and use.

We do not for a moment wish to underrate the skill of either English or continental engineers, for they have done and are now doing much excellent work, and in special lines surpass us. They make heavier forgings, thicker armor-plate and bigger guns; for the reason that until very lately the demand for material of that nature was so light in this country that our engineers and manufacturers paid little attention to its production. But even this condition of affairs is changing rapidly, and we are proving to the world that we can build ships for war as well as for peace; can arm them in accordance with the requirements of modern warfare and destroy them by dynamite appliances peculiarly our own.

As to the introduction of American ideas into England, we have studied the advertising pages of *Engineering*, as suggested by our esteemed contemporary of New York. We find there that a number of English manufacturers have adopted the box-frames for their machine tools devised by the Brown & Sharp Co., and now almost in universal use here. We find the tools of Pratt & Whitney, Bement & Miles, and other well-known American makers; Worthington pumps, locomotives with outside cylinders, cabs and cow-catcher, tubular frame double-truck freight cars, etc. We are also willing to admit that, owing in part to its contracted area and the concentration of traffic, England has more costly individual public works than the United States, has more tunnels under its rivers, a Forth Bridge and a Manchester Canal. But, on the other hand the United States has over 160,000 miles of railway as compared with the 19,000 miles of England; has more great bridges than any other single nation; has several tunnels under rivers and more building, and has miles of tunnels under the western lakes, and one 30-mile tunnel just completed to supply water to New York. The Forth bridge would never have been built at all in America; but within the next decade it will be surpassed in span, in the proportion of 2,800 to 1,700, by the six track railway suspension bridge to be built across the Hudson.

But to come back to the engineering practice of the United States and foreign countries, there are some features of our practice in which we are still unapproached, and it is just these features that give rise to a proper "conceit" among American engineers. In the extreme accuracy of workmanship, interchangeability of parts, proportioning of the members of a machine to properly perform the duty required, and, in fact, in the application of brains and conscientious study to the production of machine tools, American engineers are yet far ahead of any competitors beyond the sea. With us, for example, the bed of a planer or the frame of a machine is as carefully studied in all the strains, and the direction and amount of forces to be exerted, as if a bridge truss was under investigation; and no part of a machine is so small or so seemingly unimportant as to be slighted in this investigation. The guiding principle of our designers is that perfect machines make perfect and cheap products; and that it pays commercially to spend large sums in the perfection of a plant, because time and money are afterwards saved by the decrease in maintenance account, and the slight work required in finishing or setting up the product.

To better illustrate what is meant by extreme perfection of workmanship, it might be mentioned that only a year or so ago a "limit of error" of a plus or minus one-thousandth of an inch was the regular allowance, even to the best of our manufacturers. But the Colt's armory at Hartford, Conn., has lately delivered to the United States Government 5,000 revolvers made under a contract in which there was no limit of error; in other words, *absolute* accuracy was demanded and obtained. The same company, under an equally stringent contract, is now putting in a plant to make the Driggs-Schroeder rapid-fire guns, which means the boring of a 3-inch hole 9 or 10 feet long, absolutely exact in diameter and straightness. Work like this is only made possible by the superb machines which can be turned out by existing American tools, standards and gauges, and by the skill and experience of American designers and workmen.

That similar accurate work cannot be commercially performed on the Continent is a fact well known to those who have attempted to have American designed machines manufactured in foreign shops and with foreign tools and workmen. They will make the machines, but no two will be exactly alike; and working down to our standards and limits of error seems simply impossible. As a fact in point, we know that a prominent Berlin manufacturer of shafting declined a large order on the same specifications to which Cresson & Co., of Philadelphia, work; because the diameters required were expressed in thousandths of an inch. An American mechanical engineer, of wide experience, in visiting the Paris Exposition of last year, was particularly struck by the exquisitely graceful design and superb finish of a machine made by one of the most famed manufacturers of France; but closer inspection showed that, judged by American standards, its bearings were rough and ill-fitted, and that in the essential features of a machine, those relating to wear and usage, it was practically a mechanical botch hidden under a beautiful exterior.

For the manufacture of fire-arms, neither in England nor on the Continent are there establishments that can compare with the Colt or Winchester works; and the government manufactories of arms across the Atlantic which do turn out weapons comparing with them at all in finish and accurate fitting, are very largely provided with American machinery. In watch-making the combined skill and inventive genius of our workmen have revolutionized this industry and so cheapened the product that a really serviceable watch can be sold for a very few dollars. Leipsic, the book-mart of Europe, also makes the best type in that country, and in beauty of design often surpasses the American-made type. But it is not generally known that the most famed maker of type in Leipsic served his apprenticeship with Johnson & Co., of Philadelphia, and after going home spent over $100,000 in replacing his old machinery with American type-machines, Pratt & Whitney planers, Brown & Sharpe machines, Philadelphia shafting, and finally secured one of the brightest of Mr. JOHNSON'S foremen and made him general manager and a partner in the German house. In this matter of type, it might be mentioned that England, Germany, France, and even separate provinces of France, have each their own standard of "type-height," as makers of American printing machines intended for use in Europe have found to their cost. There is supposed to be a standard height for Europe; but the fact is that they cannot be made of a perfectly uniform height, and presses must be specially adjusted for the locality in which they are to be employed.

There is a reason for this wide difference in the engineering practice of America and the Continent, and, broadly outlined, this difference may be ascribed to national characteristics and to the force of surrounding conditions. Americans have long been noted for their inventive genius, but aside from this they are in a very great measure free from that European, and particularly English, conservative instinct that binds the user to past practice, trammels advance and frowns upon innovation. Human labor is more expensive here than in any other country, and the necessity soon became apparent for replacing costly human muscle and the uncertain personal factor, by unerring and cheaper machinery. The introduction of machinery, in unheard-of directions, from the manufacture of shoe-pegs and buttons to nobler uses, was of early date in the history of our country; and at first there was a great deal of the cut-and-try practice in its design. But even from the first there was really little of that guessing that "that will do" and then adding 50 per cent. of material to make the guess safe, that seems yet to rule among some foreign designers of machines. Material and labor were both too expensive to waste; and the same causes that combined to work out a pin-connected truss and an American wrought-iron trestle, soon pared down the frames of our machines and used metal only where it would do the most efficient work.

The practice that this training evolved was new to the rest of the world; and we do not now wonder at the caution which induced the Australian railway authorities some years ago to refuse to trust an iron viaduct of Edge-Moor make, because they could not believe that those long thin posts and slim looking braces and ties would be able to care for the loads. But the viaduct stood successfully their severest tests, and cost only £13,000; while to have built on the very substantial, sturdy English competitive design, which they were familiar with, and with which they compared the American viaduct, would have cost them just £30,000.

The type of design which we call American has necessitated careful study of the nature and behavior of materials and the perfection of tools and standards, and this perfection of design and shop practice has many advantages commercially. In bridge work it permits erection that is phenomenally rapid to our transatlantic brethren; and every member of an American bridge must be made with the full understanding that no amount of field riveting will make the parts of a pin-connected truss come together if the shop-work is scamped. By close work to standards and gauges the parts of lighter machines are assembled with almost no extra fitting; and in larger machines exact workmanship permits parts liable to wear and breakage to be kept in stock and put into a machine with a minimum of cost and labor. The fact that an idle duplicate pump, for example, can be robbed of a member to save another pump

in an emergency is a commercial advantage that has so often saved property, and possibly life, that all American users now demand this interchangeability of parts.

Our people have been educated to a higher standard of requirement than in other countries; the householder wants his Yale lock and the neatest and most artistic fittings of all kinds, and the common laborer demands Ames shovels and Disston saws. These and a multitude of other articles entering into our common everyday life must be better, stronger and cheaper than similar articles used abroad; and to meet this demand our mechanical engineers have designed and built machines whose good qualities are appreciated and recognized by all engineers, and in which Americans are justified in any amount of "conceit."

Notes by Rail.

[EDITORIAL CORRESPONDENCE.]

MANUFACTORIES AT READING.

Of course, the largest single manufacturing interest at Reading is the Reading Iron Works, which covers a large area in the southern part of the city. The works comprise blast furnaces, puddling furnaces and rolling mills, and a large tube mill. The latter is now so full of work that it takes the whole product of the rolling mill and uses besides a considerable amount of skelp purchased outside. The tube mill has been fitted up with improved machinery, but in the rolling mill the machinery is all of the old pattern. I believe the rolls are all two-high. I saw, however, one new machine, which bends the flat skelp into a tube ready for the welding furnace.

The unfortunate financial history of these works is well known, but there seems to be no reason why they should not make, at least, fair profits. At present they have an abundant market for their product, and at fairly good prices. Perhaps a thorough renovation is needed in order to have the works operated on the most economical basis, although I cannot speak with certainty on that point, as my survey of the works was a very hasty one. Reading seems a favorable location for an establishment of this sort. Both the raw materials and the market for the product are near by, and in any event, as the works are practically owned by the Philadelphia & Reading R. R., they ought not to suffer for lack of prompt and cheap transportation facilities.

At the Mellert Foundry & Machine Works, I watched the operation of making cast-iron pipe in its various stages, a process which is old enough to be familiar to every engineer, but which, I venture to say, many engineers know little about. However, it is a comparatively simple operation. The cores are made on cylindrical wooden centres. One of these is placed in a lathe, and as it revolves it is wound with rough straw rope. Upon this a workman plasters a rough coat of loam and clay. When it is brought to the desired size it is given a smooth finish with molding sand.

The flask is simply a tube of internal diameter equal to the outside diameter of the pipe to be made. The core is placed inside the flask, and a hydraulic crane lowers it into the pit ready for pouring.

The casting pit is annular in form, and the flasks are set vertically in it in a circular row. A single hydraulic crane handles the ladles of molten iron, and sets and removes the flasks. The flask is made in two halves, hinged together, and kept closed by wedge latches. As soon as the pipe has cooled sufficiently after pouring, the flask is lifted by a lug at its centre, the latches are knocked loose, and the red hot pipe drops out.

After the pipe is cooled it is thoroughly cleaned and inspected, subjected to a hydraulic pressure of 300 lbs. per sq. in.; and if no leaks are developed, it passes on to the tarring bath. Before its plunge in this it is heated over a coal fire, which "opens the pores" of the iron, and makes the coating more tenacious.

The Mellert Co. has outgrown its present quarters and is erecting works in the northern part of the city, which will have a capacity at least double that of the present establishment. It speaks well for the economy with which the works are managed that the firm has been able to take large contracts for water mains for the city of Philadelphia in competition with works located on the Delaware River, near Philadelphia, and thus having the advantage of water transportation to the points of delivery.

An establishment which seems to have a very promising future before it is the Carpenter Steel Works, located in a new suburb of Reading, about a mile north of the city. It is quite a new enterprise, ground having been broken for the foundation on Nov. 22, last; but steel made under Mr. CARPENTER'S direction has been on the market for some time, his work last year having been done at the Reading Iron Works.

The specialty of these works is the highest grade of crucible steel, fit for the finest and severest uses to which the metal is put, and for which, up to the present time, steel of English manufacture has generally had the preference.

A part of the plant is so far advanced that considerable steel is being made; but much work still remains to be done before the contemplated output of 20 to 25 tons per day can be turned out. In steel for lathe and planer tools the works have already won remarkable successes, due largely to the degree in which the steel combines the two qualities of toughness and hardness. I saw a round-nosed lathe tool which had been running for 9 hours on a chilled Salisbury iron roll, and its edge was still so keen that it scratched glass very readily.

Steel from these works has recently been tested at Washington for turning the open-hearth steel guns made at the South Bethlehem Iron Works. On the test made by the Ordnance Department a single tool took a cut of ¼ in. depth and ⅛ in. width, and turned a length of 3 ft. along the barrel of the gun without sharpening. As the gun was 30 ins. in external diameter, a simple computation shows that the actual distance traveled by the point of the tool was 2,262 ft. Two tons of this steel was ordered last month for Government use, and this will probably be about the monthly requirement.

Some of the new machinery at the works is of especial interest. What is said to be the smallest mill in the country is being erected here. It is a 3 high, 7 in. mill, and will roll steel as small as ⅜ in. square or round. The arrangement of the boilers appeared to be a very good one. There are 9 in all, most of which use only the waste heat of the puddling and crucible furnaces. All deliver steam into one large main, extending the whole length of the mill and supplying all the engines and steam hammers. In case more steam is needed than the boilers operated by the heat of the puddling furnaces can supply, a fire is started under one of the other boilers. This arrangement gives a steady supply of steam, economizes fuel, and permits cutting out any boiler for inspection or repairs without interfering at all with the running of the mill.

While the chief specialty of the works will be in high grade crucible steel, an open-hearth plant of two 10-ton furnaces will probably be erected next season in addition.

AN INDUSTRIOUS PUBLIC OFFICIAL.

I went one afternoon to call at the office of the City Engineer of Reading and found on his door the following announcement: "Office hours, 7 to 8 A. M. and 7 to 8 P. M." Inside a gentlemen informed me that the engineer was out looking after some street improvements, and would not be in till his evening office hours, so I am convinced that the legend upon the door was not a mere device to satisfy critical voters as to the industry of their city engineer. I was well aware that the office of city engineer was one in which a maximum of industry, care and faithfulness was generally rewarded with a minimum of appreciation, commendation, and last but not least, salary; but I have not before seen any one in this position who worked from 7 o'clock in the morning until 8 at night. If the other municipal officers of Reading labor as diligently in the public service, she certainly holds a unique place among American cities.

With the brief opportunities which I had for notice, I was rather favorably impressed with the results of the municipal administration. For a place of its size, and with so large a proportion of its inhabitants composed of laboring men, the city seemed to have much cleaner and better streets and sidewalks than would naturally be expected. Like many other Pennsylvania cities, a large proportion of the drainage seems to be above ground, but with the steep slope of most of the streets this is not so great an evil, except from the æsthetic point of view, and one soon gets used to the little torrent of soapy water which goes frothing down along the curbstone and accepts it as a sort of *prima facie* evidence that the inhabitants are at least making a determined effort to secure cleanliness.

HARRISBURG.

I took the Lebanon Valley branch of the Reading R. R. to Harrisburg and spent an afternoon at the works of the Harrisburg Car Manufacturing Co. I believe this is one of the oldest car shops in the country. When first started, these works were considered to do well to finish one car a week. Now they turn out 12 to 16 cars a day.

In the erecting shop I saw a novel combination box and tank car for the Union Tank line, one of a consignment of 20. It is designed for carrying oil in bulk to Pacific coast points and bringing ordinary freight on its return trip. It is built like an ordinary box car, with a square 2,000-gall. tank set in each end, thus leaving room for packing a considerable amount of ordinary freight between the tanks for the return trip. The car is fitted up with the Westinghouse brake and with a crank for lifting the coupling pin without going between the cars. The trucks have 650-lb. wheels.

The wheel foundry was not in operation, as trenches were being dug to lay a number of new hydraulic cranes. I was told that under the test specified by the M. C. B. Association, a 140-pound weight falling 12 ft., the wheels made here stand 20 to 30 blows before breaking, and have stood as high as 78 blows.

While we watched the bolt heading machines at work in the forge department, Mr. HILDRUP, the General Manager, told me that he was the original inventor of the process of upsetting bridge rods to avoid reducing the area of the section by cutting the thread. The process was first used on bridge rods made by Mr. HILDRUP in 1854, for a Mr. STONE, one of the earliest bridge builders of Pennsylvania. The process was never patented, although the preliminary steps for securing a patent were taken by Clarke, Reeves & Co some years afterward, before they learned that the process had already been publicly used.

Besides the car work done at these shops, a new ice machine is being built, and the market for it this season bids fair to outrun the capacity of the works.

What is known as the foundry and machine department of the works is located about a mile from the car department in a growing suburb of the city. Here is made the Ide automatic stationary engine, the Harrisburg traction engine, and the Harrisburg road roller. The large sale which the latter is receiving speaks well for the progress of highway improvement. During the past 9 months 20 rollers have been shipped, and 18 rollers, for which orders have been received, are now in the shops. They are built in 10, 12 and 15-ton sizes, but the 12-ton is the size for which there is most demand.

In the boiler shops here I saw a pneumatic caulking tool at work turning over the ends of boiler tubes. The foreman told me that one man with this tube caulked 88 tubes 3¼ ins. in diameter in an hour and a half, whereas, by the old hand process it would have taken 15 men a half day to do the same work. Its work on the tubes was very neatly done. Its light and rapid blow seems well suited to this work. For caulking seams and rivets it has not been found so successful, I believe, as it does not strike a heavy enough blow. It is also pretty severe on the operator. A man needs a cast-steel elbow to stand the recoil from the several thousand blows a minute which the tool strikes, as well as an ear drum of sole leather to endure the noise. But it is such a labor-saving tool that it seems certain to come into very general use, notwithstanding these drawbacks.

THE PENNSYLVANIA STEEL CO.'S WORKS.

Steelton is properly a suburb of Harrisburg, 3 miles down the Susquehanna River from the city. The works of the Pennsylvania Steel Co. here are located on a broad belt of the Susquehanna bottom lands, with the main line of the Pennsylvania R. R. between them and the river. A

branch of the Philadelphia & Reading road also runs to the works from Harrisburg.

The works give employment to about 4,000 men, and are run night and day. In the frog and switch department they are now running 120 hours per week, and are not able to keep up with orders. During the month of February about 1,500 frogs and 750 switches were turned out. As soon as possible a large addition is to be made to this department, which will about double its capacity. In the frog shops the material is taken in at one end of the shop and passes to the cold saw, which, by the way, is about the most energetic tool I have seen. It has a circumferential velocity of four miles per minute, and slices off a 70-lb. rail in 40 seconds. The saw is driven by a 50 H. P. Westinghouse engine, and is belted up to the high velocity above noted. The saw itself is 42 ins. in diameter, and made of soft iron, No. 6 B. & S. gauge. It is hung on a 3-in. shaft in a pendulum frame, which is fed up to the rail by a worm gear connection. The pulleys between the engine and the saw are all of wood, except the 14-in. pulley on the saw arbor, which is of iron. The 14-in. belt which drives this pulley runs at the rate of 1⅛ miles per minute, and the problem of finding a lacing for this belt which would stand has been a perplexing one. Annealed iron wire has finally solved the problem. A lacing of this material runs without stretching, and will last about a month before it is so worn as to require renewal. The saws last about six weeks before they are worn down too small for use. They are made with rough teeth, which help to cool the saw and prevent it from heating and dishing.

The philosophy of operation of the cold saw (which, by the way, is very inappropriately named, inasmuch as it is the hottest kind of a saw when it is getting in its work), is simply that it melts the surface with which it is in contact by the heat of friction. Steam is turned on and the saw starts up with a savage whirr. As it touches the rail it grows red hot for its whole circumference, a shower of sparks flies from the point of contact, the rail glows red where the saw touches it, and in 40 seconds the rail is cut through.

It has been thought anomalous that a soft iron disk should cut a hard steel rail, but its action is not a cutting one by any means. It simply does to separate the rail what the electric welding current does to join it—produces a melting heat at a single point. The rail melts instead of the saw because the saw touches the rail for only a small portion of its circumference and has time to cool somewhat during the rest of its revolution.

Another machine which I saw doing rapid work in metal cutting is a new planer working on rails for frogs and switches, which returns at five times the cutting speed. The belts by which it is driven run a mile a minute, and there is no shifting of belts as in the ordinary planer.

In the signal department I examined with much interest the magneto-electric signal, designed to give warning at highway crossings of the approach of a train. An exceedingly ingenious detail of this machine is a friction ratchet by which the intermittent motion taken from the track levers is converted into a continuous rotating motion. A still more interesting feature from a scientific point of view is the permanent magnet used in the machine. It is made from a special grade of hard steel, and a magnet weighing a pound and a half will lift a weight of 17 lbs. The production of these magnets was the result of long and careful experiment. So far as I can learn they are far stronger than any other permanent magnets of their size ever made.

The machine is in quite extensive use, although as compared with the number of unprotected crossings in the country the number is pretty small. I suppose the main reason machines of this sort for giving protection at highway crossings are not more in use is principally on account of the expense, but sooner or later it seems that something of the sort will have to be done. Grade crossings in cities and towns and on a few railways of very heavy traffic will be removed, but it will be a very long time before the remaining nine-tenths of the country's grade crossings can be eliminated. Some sort of protection ought to be, and in time will be, given to highway crossings of this class.

I took a hasty tour through the steel department, where two Bessemer converters and two open-hearth furnaces are at work. The ore received here comes principally from Cuba and Spain, but occasionally freight rates fall low enough to let in a few carloads of Bessemer ore from the Lake Superior districts. Most of the ore is landed at Baltimore and shipped thence by rail to Steelton. The new plant now being erected at Sparrow's Point, Md., near Baltimore, will enable the company to take the ore direct from the ship's hold to the furnaces, which will give, of course, a considerable economy over the present method of shipment by rail. The works at Sparrow's Point already employ about 400 workmen, and are being rapidly pushed forward to give capacity for a much larger force.

Probably the plant at this point will be erected to work direct, the converters blowing the molten iron from the furnace before it is cooled, thus saving the expense of remelting in cupolas. I believe the Steelton works also will eventually adopt this system.

One open-hearth steel furnace is now being operated on the basic method and is turning out a very fine grade of steel. I saw the records of some tests which showed an elongation of 36 per cent.

One of the most interesting things about the whole works was the template board, on which are hung the standard sections of the rails rolled for many years past. Practically all the rails now turned out have the sharp corner, nearly vertical side and ample bearing for the angle splice, which are evidently to be characteristic features of the coming rail. In comparison with this modern type I noticed an old template on which the head of the rail was the shape of an ellipse. It is encouraging to know that the design of a rail section on scientific principles has triumphed so quickly over the old empirical designs which so long held sway.

[TO BE CONTINUED.]

CORRESPONDENCE.

Locomotive Truck and Equalizers.

CONNELLSVILLE, Pa., March 24, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: As regards the truck and equalizers, which you say are among the new features in the modern English engines, permit me to state they are old in English practice. In 1860 Stephenson built express engines for the London, Chatham & Dover R. R., with trucks. Caledonian engines built in 1865 had equalizers, or as we called them then, compensating beams. H. WARD.

[There were single instances of the use of these devices in England even earlier than the dates given by our correspondent. Their use has not become general until very recently.—ED. ENG. NEWS.]

Rule for Vertical Curves.

JALAPA, MEXICO, March 25, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In my letter to you of Jan. 31 about the "vertical curves" rule used on the Mexican National Railway I said that this was used for the metric system in which the total length of vertical curve is 200 meters, 100 on each side, and for which it is properly used, but in making a rule for the foot system the formula needs a little variation on account of the total length of vertical curve being 500 ft., 250 on each side. Dividing the half length of the curve into 5 equal parts of 50 ft. each, we have the following rule:

Call the divergence of the grade lines, or the algebraical difference of the two rates of grade per 100 feet = a

Call $a \times 2.5 = A$.

Then, the distance from grade line or tangent to the curve will be:

At intersection of grades (apex dist.)	=	$.25\ A$
" 50 ft. each side of apex	=	$.16\ A$
" 100 " "	=	$.09\ A$
" 150 " "	=	$.04\ A$
" 200 " "	=	$.01\ A$
" 250 " "	=	.00 tang. point

So that the first rule given in my letter of Jan. 31 is all right for the metric system, but I omitted to state that A *in the foot system* represents the divergence of grade lines or algebraical difference of the two rates of grades per 100 ft. multiplied by 2.5. As I mentioned Mr. H. H. FILLEY's name in relation with this matter, I should like to explain it as I have done above. E. RAYES.

The Determination of Stresses in a Truss.

HOBOKEN, N. J., March 22, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The article in your March 1 number on the computation of stresses moves me to some reply. While its main object seems to be to describe a particular mechanical device for facilitating such work, it contains ambiguous and questionable statements on the general subject of stresses, and in the illustrative example,

The objections raised in the second and third paragraphs to wheel-load concentrations and methods by which the stresses resulting therefrom can be readily calculated are ambiguous. Suppose that by some mathematically correct method of treating a system of concentrated loads the stress in a certain piece might be calculated in, say, 10 or 15 minutes, and found to be 25,430 lbs.; it is not clear whether the author denies that such a stress could be calculated in this time, or that such a method would not be a brief one.

Then, again, what is meant by "mathematical accuracy" is not clear.

The late Professor GILLESPIE made a distinction in such cases between accuracy and precision, which will be useful in what follows. In accordance therewith the former applies rather to the left-hand and the latter to the right-

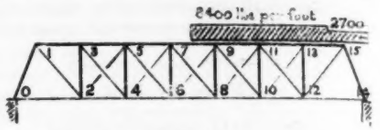


Fig. 1.

hand figures of a quantity, so that to state the above stress at 25,000 lbs. would be accurate but not precise, while to state it as 24,430 would be precise but not accurate.

We should be sorry to think that, by "misplaced mathematical accuracy," a professor in an engineering school can mean anything more than unnecessary precision, and the illustration used, of a micrometer on a rope, accords with this interpretation.

Upon this supposition, and supposing that we have a method *capable* of giving "an absolutely, mathematically correct result," or, in other words, a result both accurate and precise, how can the capability of the method be regarded to its discredit? Undue precision can be avoided; in fact, there is no more necessity for it in this method than in that which the article explains and advocates, or than there is to carry out an ordinary division or square root extraction to a useless number of decimal places.

On the other hand, however, not only is there no undue precision evident in the article, but it contains inac-

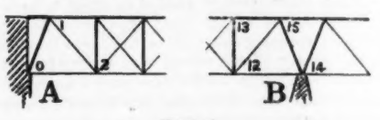


Fig. 2.

curacies in the application of the principles of mechanics to trusses; it may be, therefore, that accuracy, as well as precision, is regarded as to some extent undesirable.

The reason given for contempt of accurate calculations of minimum stresses is faulty. How can the wide gap "between a 6,000" lb. stress and the "limit of elasticity" of "25,000" lbs. in the member sustaining the stress be an argument for inaccuracy in the former? The 6,000 lbs. is obtained by dividing the 25,000 by a factor of safety of about four, or, to put it another way, if the calculated stress is 6,000 lbs., the piece to sustain it must be made four times larger, for absolute safety, than the stress calls for. Now, no matter what gap then may be between the two, an error of 5 per cent. in the calculation of the stress means the same per cent.—that is, an error four times larger—in the size of the piece to sustain it, and if the amount of the error is uncertain a greater allowance must be made.

I believe it to be a truth, fast gaining recognition, that the best engineers make the most complete and accurate calculations of their work.

It savors of inaccuracy, in the fifth paragraph, to call the preliminary matter to be presented "elementary

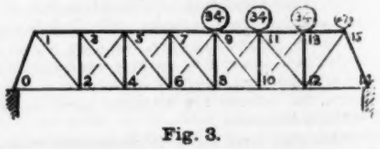


Fig. 3.

principles of graphical statics." It is simply a statement of the *results* of analytical and graphical statics applied to a special form of truss.

The first three lines of the paragraph numbered "2" lack precision. From *what* "point in the panel" does the load extend "to the further abutment"? The last three lines and Fig. 2 contain a slight inaccuracy, which should not be allowed in a mathematical statement, although it can cause but a slight error in numerical results. The parabola, Fig. 2, should really be tangent at y' to a right line from C to O, and the one drawn is merely a sufficiently good approximation to it.

But, to avoid too much criticism, we pass at once to the illustrative example,

Fig. 1 is the truss and loading described in the example with its accompanying Fig. 6. There is some lack of precision in the omission to state the way in which the road bed is continued at the ends of the truss. Fig. 2 shows two ways, *A* and *B*, to continue it, and the stresses have been calculated for both. Fig. 3 gives the old way of representing a moving load by joint loads, for which the stresses have also been computed. These stresses are given in the following table and compared with those calculated by Prof. FLETCHER. We have regarded the stress 13,900 in his table as evidently a mistake and have copied it as 13,400:

COMPARATIVE TABLE OF MAXIMUM STRESS ON INCLINES

Due to a moving load of 2,700 lbs. per linear foot, for two trusses, with 700 lbs. per foot additional for three panels at the head of the load. See Fig. 1.

		0.	1.	3.	5.	7.	9.
	Maxima for a moving load of 2,700 lbs. per foot.						
2.	Values from Prof. Fletcher's table, column 5	99,900	76,200	55,500	38,500	24,500	13,500
3.	Graphical re-calculation, or check of these values	99,900	76,500	56,200	39,000	24,900	14,000
4.	Arithmetical recalculation of the same	99,900	76,490	56,190	39,020	24,970	14,050
5.	Errors of Prof. Fletcher's calculating apparatus		290	690	520	470	550
6.	Correct values of the maximum stresses:						
	A	93,600	75,370	53,970	36,130	21,850	11,150
	B	99,000	75,760	54,360	36,520	22,240	11,540
7.	Prof. Fletcher's corrected values too large by—						
	A	6,240	1,120	2,220	2,880	3,120	2,900
	B		730	1,830	2,500	2,730	2,510
	Maxima for a moving load with an excess load.						
8.	Correct maxima for the load as shown in Fig. 1:						
	A	107,960	87,200	63,710	43,690	27,130	14,040
	B	113,780	87,590	64,100	44,080	27,520	14,510
9.	Stresses for the excess load. See table, col. 7	15,800	13,400	10,900	8,500	6,100	3,600
10.	Prof. Fletcher's maxima, line 4 + line 9	115,700	89,890	67,090	47,520	31,070	17,650
11.	Prof. Fletcher's maxima too large by—						
	A	7,740	2,690	3,380	3,830	3,940	3,610
	B	1,920	2,300	2,990	3,440	3,550	3,140
12.	Maxima for moving load of joint loads. See Fig. 3	115,680	89,890	67,120	47,520	31,040	17,690

Line 1 of this table gives the numbers of the inclines as shown in Fig. 1. Line 2 gives the maximum stresses for a uniform moving load of 2,700 lbs. per ft. (on two trusses and without the excess load), as calculated mechanically and tabulated in the article. The correctness of these results depends upon (a) the correctness of the method by which they are computed, and (b) the precision with which the computing machine did its work. To test the latter point line 3 was obtained by a computing device of much simpler construction, which will be explained in connection with Fig. 4, and the values were checked by a numerical calculation giving those in line 4. Both lines were computed by considering the stresses to vary as the ordinates of the same parabola, as is used by Prof. FLETCHER. It should be remarked, however, that the stress from the *O* incline should, according to a statement in the article, correspond to the ordinate at its centre

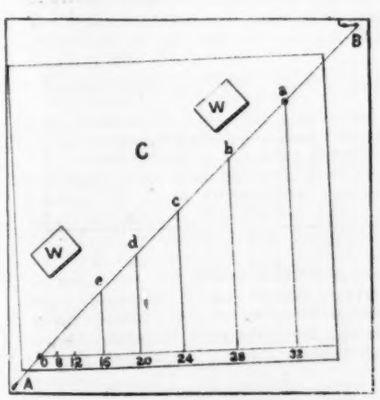


Fig. 4.

rather than to the end ordinate, making the stress 93,750 instead of 99,900. Line 5 gives the difference between lines 2 and 4, and shows that the values given by his computing apparatus average 500 lbs. too small. Lines 6 give the true maximum stresses for this load, supposing, first, that the floor system is connected at both ends of the truss in the way shown at *A*, and, second, that it has both ends like *B*, Fig. 2. Lines 7 show the errors in Prof. FLETCHER's values due to his method of calculating them, and are obtained by subtracting lines 6 from line 4.

The correct maxima for the load shown in Fig. 1, where the excess load of 700 lbs. per ft. extends over three panels is given in lines 8. The method of the article for finding such maxima is to add to the stresses already found (see line 2, though we shall use the arithmetically computed values, line 4), the stresses due to the 700-lb. excess load. These latter are given in line 9 and the results of the addition in line 10. Lines 11 are found by subtracting lines 8 from line 10, and show that the values obtained by the addition are much too large. Line 12 contains the maxima for a moving load composed of joint loads (see Fig. 3), and amounting to the same weight per foot as the continuous load.

This table shows that the method employed in the paper for calculating maximum stresses gives values from 1 to 25 per cent. too great (compare lines 7 with 6 and 11 with 8), and, further, that these values, claimed to be the maxima for the continuous loading, Fig. 1, are substantially the maxima for the discontinuous, Fig. 3.

The reason of this is that the method employed is crude and incorrect, both for the uniform 2,700 lb. load and for the same with excess load added. In the latter case it may be well to remark that, strictly, the maximum stresses cannot be calculated for the uniform and excess loads separately and added to get the final maximum, because when each is in the proper position for its own maximum the heads of the two loads will occupy different positions from each other and from that of the combined load.

In view of the preceding the advocates of continuous loading will need some better arguments than are contained in the article. The fact is that the computations for discontinuous loading are quite as simple as those for continuous loading, with an excess load; indeed the method of the article for calculating the continuous loading virtually supposes it to consist of joint loads.

It must further be evident that the adoption of a representative continuous load presupposes calculations, both for the actual load and its representative, to show that the maxima due to the latter are never less than the actual maxima. Continuous load computations would seem, therefore, to have this extra labor necessarily attached to them.

As to the question of the degree of precision desirable in computing stresses opinions may vary. The day has, however, passed for regarding a reasonable degree of precision as a waste of mental labor; in fact, it is a great saving thereof to use processes known to be correct, and to carry them out with such precision as will keep the results within an acceptable per cent. of the true values.

We should be glad could Prof. FLETCHER be induced to consider the "contempt of such *misplaced* mathematical accuracy" which he confesses as more properly a misplaced contempt for mathematical accuracy.

Fig. 4 represents the graphical or mechanical device for obtaining the values in line 3. *A B* is a flat drawing board, across which is stretched, between the pins *A* and *B*, an extremely fine wire or a human hair. *C* is a piece of cross-section paper accurately divided, say, in inches and tenths or twentieths. A point at one corner being chosen for the zero, the squares of the natural numbers are marked off from it along a line to the right, and the divisions thus made are suitably figured. Thus, the square of 20 being 400, a mark is made at the 4-in. line and 20 written beneath it, and so on for all the squares. To make use of this device to obtain a series of values varying as the ordinates to a parabola, we have only to lay off one of the valve opposite the the proper division, place the paper in position beneath the hair and read off the rest. Thus, to obtain line 3 in the table, the value 99,900 was laid off by making 32*a* equal to 9.99 in.; the paper was then adjusted with some precision, so that both 0 and *a* were directly beneath the hair, and weights *W W* used to keep the paper in place. The remaining values 28*b*, 24*c*, 20*d*, and 16*e* were then read off and entered in the table. The reason for laying the greatest value off at 32 is that the latter is a multiple of 8 and, further, that the middle of the 0 incline is one thirty-second of the span from the abutment. The value for this place, previously mentioned as 93,750, was read opposite the 31 division, not shown. Of course no lines, 32*a*, 28*p*, etc., are drawn upon the cross-section paper.

This device will do all that the one described in the article will do (there is no parabola to draw), and it requires but one setting for the whole series of values. If a series in arithmetical progression is wanted the ordinary divisions of the paper are used in place of the series of squares. Values can also be written according to many other laws; thus, another sheet of paper may have reciprocals instead of squares of the natural numbers, and upon it a series of values can be obtained, varying as the equidistant ordinates to a hyperbola. There is no difficulty in reading upon a device of this size to within a hundred pounds of the true values.

J. BURKITT WEBB,
Prof. App. Math., Stevens' Inst. Tech.

The Course of the World's Iron Production.

NEW YORK, April 8, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The table in your last issue showing the pig iron production of the world since 1830 forms, with your additions of percentages, a decided and valuable contribution to the stock of information on that subject. It may be unfortunate, however, considering the lack of statistics for the years 1840, '45 and '50, that so far-reaching a generalization was made, for, as will be seen on pages 163 and 164 of Mr. J. M. SWANK's "The American Iron Trade in 1867," our production reached 315,000 gross tons in 1840, and 800,000 for the years 1847 and '48, to drop as shown in the table to 565,000 tons in 1850 and 500,000 in 1852.

There are no statistics for 1851 or 1853, but in 1852 the production was only 500,000 tons, rising to 657,000 tons in 1854, when the American Iron and Steel Association commenced taking statistics; 788,000 tons in 1856, 629,000 tons in 1858, 812,900 tons in 1860, and 653,000 tons in 1861. So that for the four years ending with 1850 our average make was 715,951 tons, and for the five years ending with 1861 it was 713,427 tons. Our population, which in 1850 was 23,191,876, increased to 31,443,321 in 1860, and the production of British pig iron, which was 1,396,000 tons in 1840, rose to 3,827,000 in 1860. These two figures are taken from Fossick's "History of the Iron Trade," published by Spon. England then had a start of over three million tons ahead of us. During the depression in our make in 1870 it was 4½ million, and it remained between this figure and four million tons until 1884. Or to state it by percentages, of the total pig iron produced in the two countries, in 1861-2-3 and 5 we made between 15 and 16 per cent., in 1869 this had increased to 23.8 per cent., to fall to 20.4 per cent. in 1870, from which time our proportion increased with slight irregularities to 45.1 per cent. in 1888.

From what has been written above it will appear that there was a case of arrested development in this country between 1846 and 1861. And further, that any comparison of our rate of production which includes 17 years of stagnation, introduces an element, which, in view of a nearly steady increase of British production during the same time, must be regarded as abnormal; as was the slight drop in our production from 1869 to 1871, while England was increasing her production by over one million tons. And it is believed that under these circumstances there will be substantial agreement on your part with my contention that our rate of progress should be reckoned from 1861 instead of 1830.

If that is done, and we take the table on page 122 of the statistical report of the Secretary of the British Iron Trade Association for 1888, we will find that the production for the 28 years and the last 10 years in the United States, the United Kingdom, Germany and France has increased as below:

	U. S.	U. K.	Germany.	France.
1861 to 1888	9.936 times	2.077 times	9.040 times	2.036 times
1879 to 1888	2.367 "	1.311 "	1.899 "	1.256 "

It will be noticed that there is a marked similarity between this country and Germany, and between England and France; this is heightened in the latter case by the fact that both countries were at their maximum output in 1882-3, and have fallen off since, and they are the only two countries mentioned in the tables last referred to that have. Belgium and Austria-Hungary, with an aggregate production a little larger than France, have had very nearly the rate of increase shown by England and France. Two of the above countries, England and Germany, do a large export trade. France does not export a great deal, and until the last calendar year, our exports of iron and steel have not approximated our imports since 1846, and the depreciation of our rate of advance, even without referring back to the *Tribune's* showing of an increased consumption per capita of 344 per cent. of domestic production, seems unwarranted by the facts.

The English increase of production is not directly related to the increase of domestic consumption, as in 1861 1,359,399 tons of iron and steel, or 36.6 per cent. of production, was exported, while in 1888, 3,966,563 tons, or 50.2 per cent. was exported. Of this the Board of Trade returns show that 1,087,904 tons of railroad iron and rails went to countries outside of the United States, Europe, China and British India; so that it is possible, if not probable, that the extension of railroad building, with the industries which accompany railroad building, in such countries as Mexico, South America, Japan, Australia and South Africa, have given England an addition to its foreign market equal to its total sales in 1860; and to the extent that the supposition is correct, the peoples of such countries should have been included in the population of Great Britain, and to some extent in the population of the rest of Europe, as those countries which have lately subsidized their steamer lines have recently increased their exports of iron and steel, as well as other goods.

In 1846 our iron masters hoped not only to supply our own market, but influence, if not control, the prices of the world. As, for the five years 1842-46, our imports of iron and steel averaged a total value of less than 6 million dollars, as against over 25½ millions for the next 15 years, the hope would seem to have been reasonable, and we will, I trust, agree that from 1861 we have been, to a greater or less extent, "recovering lost ground."

The paralysis of our iron production from 1847 to 1861 can only be explained by a reference to our fiscal legisla-

tion. From 1840 to 1842 the duty on pig iron was $10.00 per ton; from 1842 to 1846, $9.00; from 1846 to 1857, 30 per cent., *ad valorem*; from 1857 to 1861, 24 per cent.; from 1861 to 1864, $6.00 per ton; from 1864 to 1870, $9.00; from 1870 to 1883, $7.00, and from 1883, $6.72 per ton. The drop in production in 1870 was greatly the result of fear that the reduction of duty would be taken off the price of pig iron; the demands of the country, however, continued increasing, and whereas our imports of iron and steel for the three years ending 1870 were valued at $108,834,167, those imports for the three succeeding years were valued at $219,655,434. England supplied our deficiency and we "paid through the nose" for it, as Germany is now paying for not increasing her make of pig iron with her consumption. It should also be noticed that from 1862 to 1876 as much money was collected from internal revenue as from duties on imports, a large part of the internal revenue taxes then falling on productive employments and trade, instead of on spirits, beer and tobacco, "the luxuries of the poor"—as at present, counterveiling the stimulating effect of the tariff on our production.

During this period, from 1846 to 1876, a net balance of trade of over $1,500,000,000 was rolled up against us to which our purchases of foreign-made iron and steel contributed over $900,000,000, or about 60 per cent. Along with the high rate of interest inseparable from the great loss of money mentioned, and the loss of the labor and freights that would have been employed producing and assembling the raw materials necessary to make the iron we purchased, went the control of the iron market, which made England the builder of iron ships and heavy machinery for the world.

Possibly a worse loss, to engineers at least, has been a national habit of depreciating everything American. This may be illustrated by the recent proceedings at and about the Forth bridge, Sir JOHN FOWLER saying, among other things, that he was "proud, moreover, that it was the *work of British workmen;* proud, too, that it was *constructed of British material*," nearly the whole proceedings having been conducted with a view to boom British engineers and sell more British iron; whereas if the ceremonies connected with opening such a bridge had occurred here, some resounding demagogue would have been pushed to the front, who would have made the central point of his speech an assertion that our tariff had added 40 per cent. to the cost of the bridge, though he knew that when our friends had found our market short of iron they had more than once doubled the price on us, and there is nothing to show that we would now be making over a million tons of iron a year, if it had not been for our fiscal legislation.

The result of the demagogue is that when foreign nations want an engineer—well, they come here before they go to Corea.

EDWARD P. NORTH.

[Our correspondent carries the discussion into a field where we cannot well follow him when he discusses, not simply the facts, but the political and fiscal causes and explanations of those facts. We understand his claim as to difference in facts to be simply this: That, although it is true that comparing the 1830-40 period with our own period, we are not making as large a share of the world's iron output as we were then, relatively to population and wealth, yet that there was a period of "arrested development" between 1846 and 1861, and that our rate of progress should therefore be reckoned from the end of this period, 1861, just at the outbreak of our great war.

We can by no means accept this as the fairer basis of comparison, for the very reason that he proposes to start from the end of a frightful period of political uncertainty and disaster, when war or great changes were plainly in the air. Since then the shoe has been on the other foot. An assured national future has given investors in all kinds of enterprises a feeling of certainty and confidence, while England, if either, is the country of uncertain future conditions. It is our belief that these great differences have had a most important influence on industries of all kinds, and if so, the only fair way to take a large view of the general tendencies of the last half century is to avoid the disturbing effect of our great war by not taking dates too near it for comparison.

Comparing 1850 with 1880, the last date for which we have population records, however, in 1850, with 84 per cent. of the British population, we produced one-quarter as much pig-iron. In 1880 with 146 per cent. of British population, we produced one-third as much iron. Had our iron output increased as fast as our population, we should have produced 43 instead of 33 per cent. of the British product, since our proportion to the British population had increased in that era 1.74 times. Our correspondent's letter is received too late for us to go further in discussion, but the figures which he gives enable us to complete the following tables from which any one can judge for himself, in connection with the statistics of the world's product which we gave last week, how true it is that the significant date from which to start comparison is 1861. The dates of the table given last week were chosen simply from the accidental fact that they were the only ones given in the statistical abstract of the American Iron and Steel Association, from which we took our figures. To us it seems clear that the period when our iron output was most remarkably great, *compared with that of the rest of the world*, was in 1830-50. ED. ENG. NEWS.]

Pig-iron Output of the United States and United Kingdom in Thousands of Gross Tons, 1830 to 1888.

	Thousands of Gross Tons.			P. c.	
	U. S.	U. K.	Total.	U. S.	U. K.
1830	165	682	847	19.5	80.5
1840	315	1,396	1,711	18.4	81.6
1850	565	2,249	2,805	20.2	79.8
1856	789	3,586	4,375	18.0	82.0
1860	812	3,827	4,639	17.5	82.5
1865	831	4,825	5,656	14.7	85.3
1870	1,665	5,964	7,629	21.8	78.2
1875	2,018	6,365	8,383	24.1	75.9
1880	3,835	7,749	11,584	33.1	66.9
1885	4,045	7,417	11,462	35.3	64.7
1888	6,490	7,900	14,390	45.0	55.0

Population and Wealth of the United States and United Kingdom, 1830 to 1888.

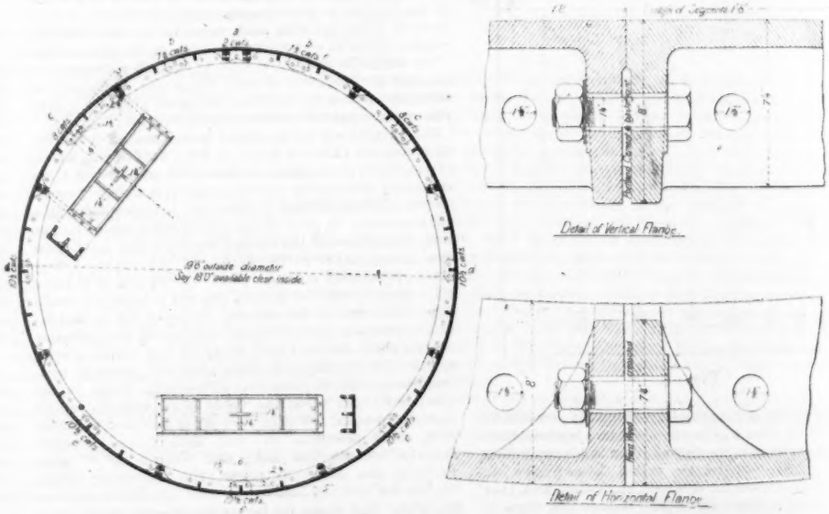
	Population in millions.		Wealth in millions of pounds sterling.	
	U. S.	U. K.	U. S.	U. K.
1830	12.9	24.1	500	3,700
1840	17.1	26.8	800	4,030
1850	23.2	27.4	1,686	4,800
1856	....	....	2,850	5,200
1860	31.4	29.1	3,866	5,560
1865	....	....	5,150	6,100
1870	38.6	31.7	7,074	6,800
1875	....	....	8,100	7,600
1880	50.4	35.0	9,495	8,350
1885	....	....	11,100	9,200
1888	65. (?)	38. (?)	11,900	9,700

The population statistics for the United Kingdom are for one year later than that given, *i. e.*, for 1851, 1861, etc., making them slightly too large. The wealth statistics are taken from MULHALL'S "Dictionary of Statistics," filling in the odd years desired by constructing a diagram. Such figures are, in any case, mere rude approximations, so that the process is quite sufficiently accurate.

Cast-iron Lining—Hudson River Tunnel.

In our issue of March 15, we gave an illustration of the shield that is to be used in excavating the tunnel under the Hudson River, and now follow this with the detail of the cast-iron lining-plates, as reproduced from a tracing kindly furnished by Mr. WM. R. HUTTON, the Chief Engineer of the tunnel.

This lining was fully described in the issue referred to, and little more need be said about it, as the drawings are self-explanatory.



Cast-iron Lining, Hudson River Tunnel.—WM. R. HUTTON, *Chief Engineer.*

THE THURLOW 6-IN. CAST-STEEL GUN has been tested a second time at Annapolis. With a charge of 48 lbs. of prismatic powder an initial velocity of 2,000 ft. per second was given to the 100 lb. projectile. The official report, not yet issued, is expected to be favorable to its acceptance by the government.

Tornadoes in the United States.

We are indebted to Mr. H. A. HAZEN, of Washington, D. C., for the following valuable notes on tornadoes. Mr. HAZEN has made this subject an especial study, and will shortly publish an extensive treatise upon their occurrence. We are particularly indebted for his correction of several statements in our issue of April 5, taken from such sources as were available at the time. Mr. HAZEN writes as follows:

The recent severe tornado in Louisville, Ky. (March 27, 1890, at 8:10 P. M. central time), has brought out many statements regarding these outbursts, which are not always exactly according to fact. In studies of tornadoes great confusion has arisen from a lax method of grouping them without taking any account of their violence. There has recently been published a statement that this country had been visited by 2,435 tornadoes and that the aggregate loss from these was $941,282,500, or $386,564 for each tornado. A careful study of all the most severe tornadoes between 1873 and 1888 has shown the number to be 48 and the average loss $203,000. The total number of tornadoes in the same period was 2,221 and the average loss $17,645; this shows that the first estimate above has been exaggerated more than 20 times. This is a much more important matter than appears at first sight. There are a large number of companies that insure against loss from tornadoes, and the amount of this loss should be accurately known, both for the benefit of the insurer and the insured.

The loss by fire is most carefully determined, and it is thought that the amount is known within 4 per cent. of the truth; but in the case of tornadoes, such estimates as the above, made, perhaps, by interested parties, have put the loss about 20 times too great. A most careful collection of statistics of tornado losses for the tornado States, and of fire losses for the same, during the period 1876-1884, shows for the former $24,160,000, and for the latter $462,324,000. If we multiply the first of these by 20, we shall see that the resulting hazard is the same for tornadoes as for fires, whereas, in reality, it is only 1-20th.

There have been given several lists of severe tornadoes which have been erroneous in many points. It may be of interest to note the 13 most violent tornadoes since 1873.

1877, June 4, Mt. Carmel, Wabash Co., Ills. Struck at 4:30 P. M.; width of path, 200 to 400 ft.; length, 7 miles; velocity, about about 38 miles per hour; 16 persons killed; 100 injured; great destruction of property. Loss, $400,000.

1878, Aug. 9, Wallingford, New Haven Co., Conn. At 5:45 P. M. a dark cloud approached the village from the West. "Electricity of the most terrific kind filled the air." "Straight rods of fire came down from the sides of the cloud to the earth." At 6 P. M., over a pond just west of the village, a cloud from southwest united with the one from the west. The

funnel-shaped cloud from this union passed almost due east. Its path was marked by the débris of the houses, all timbers and boards lying parallel to each other as though a mighty river had passed. Thirty persons killed, 70 wounded, 55 houses destroyed. Loss, $250,000.

1880, April 18, Marshfield, Webster Co., Mo. Near the town; trees 3 ft. in diameter, for a space of several hundred yards in width, were lifted entirely out of the ground. Every house excepting 6 in this town of 2,000 people was destroyed; 65 persons killed and 200 wounded. Loss, $110,000.

1881, July 15, New Ulm, Brown Co., Minn. 6 persons killed, 53 wounded, 47 buildings "blown to atoms," 200 unroofed or destroyed, 102 families homeless. Loss in town, $400,000.

1882, June 17, Grinnell, Poweshiek Co., Iowa. 60 persons killed, 150 injured, 140 houses ruined in 5 minutes. Loss, $600,000.

1883, April 22, Beauregard, Copiah Co., Miss. Every house and store in a town of 600 people destroyed. Solid iron screw of a cotton press weighing 675 lbs. was carried 900 ft.; 29 persons killed, 40 wounded. Loss, $450,000.

1883, May 18, Racine, Racine Co., Wis. 25 persons killed, 100 injured, 150 houses destroyed. Estimated loss, $200,000.

1883, Aug. 21, Rochester, Olmstead Co., Minn Large part of town destroyed. Length of path 18 miles. 31 persons killed, 135 houses wrecked. Loss in county, $200,000.

1885, Aug. 3, Camden, Camden Co., N. J.—Path from one to two squares wide ; 6 persons killed, 100 injured, 500 houses blown down or unroofed. Loss, $500,000.

1885, Sept. 8, Washington Court-House, Fayette Co., O.—Town almost destroyed; 40 business houses and 200 residences in ruins; 6 persons killed, 100 injured. Loss, $500,000.

1886, April 14, Saint Cloud and Sauk Rapids, Minn.; 74 persons killed, 136 wounded, 138 buildings destroyed. Loss, $400,000.

1887, April 21, Prescott, Linn Co., Kans.; 20 persons killed, 237 wounded, 330 buildings demolished. Loss, $150,000.

1888, Feb. 19, Mt. Vernon, Jefferson Co., Ill. Large part of town of 8,000 inhabitants demolished; 18 persons killed, 54 wounded, 100 buildings destroyed. Loss, $400,000.

To this list is to be added the latest:

1890, March 27, Louisville, Jefferson Co., Ky. Tornado struck at 8.10 P. M. Path ¼ mile wide through thickly peopled part of city; 76 killed. Loss, $1,250,000.

It is probable that most persons, when reading of a tornado in the West, picture to their minds such a catastrophe as one of the 14 just described. We should remember that in 18 years there have been only 13 such visitations in this country, not including Texas, that there have been 35 others not nearly as severe, and the great number remaining (2,173) were comparatively light, causing an average loss of only $13,500. It is not intended to belittle the terrible nature of these outbursts, but simply to give, if possible, an accurate presentation of the subject.

The Railway Mania of 1846 in England.

From an article in the *Railway Press*, of London, we abstract the following account of the great railway mania of 1846, which was like a tidal wave of railway speculation, and ended in widespread disaster. At that time almost any person, whether qualified or not, could obtain employment as an engineer, while the fees demanded and paid were often very high:

It was perhaps to be expected that a period of extraordinary prosperity should have been marked, in its early stages, by much rashness in speculation and consequent insecurity of capital, such as produced the panic of 1846, when 272 railway acts were passed. Yet the government of the day had been in great part to blame. They had allowed lines to be laid down, in many instances, which aimed at local rather than national benefits, thus necessitating innumerable patchings and crossings. The railway department of the Board of Trade had shown itself so unequal to its duties that there was always much uncertainty attaching to applications for leave to construct railways. The preliminary requirements, as regards the deposit of plans and documents, were excessively stringent, while, on the part of government officials, there was the usual inability to cope with broad principles. In the previous year the deposit on railway capital by promoters was raised to 10 per cent., the object of this being to insure greater financial stability in these undertakings. But the actual result was that promoters obtained the amounts of deposits for the purpose of initiating schemes that were never intended to be carried out. Companies were launched in great numbers, and in Leeds alone it was a common thing for 100,000 shares to be sold between morning and evening. The new railways authorized in 1845 involved a cost of about $220,000,000, and the shareholders seem to have represented all classes and callings from high to low. The fact was, that by increasing the deposit to 10 per cent., Parliament had given to lawyers and promoters a fund out of which they could pay themselves, so that the more companies they could foist on the public the richer they would become. According to the *Atlas*, engineers not worth two guineas ($10.50) a day in 1844 "turned up their noses at seven guineas ($36.75) a day" in the following year. Things went on briskly with railway surveying, the 10 per cent. sufficing amply to defray preliminary expenses. Corruption and expense became the order of the day, and the very waiters at inns were retained to report the motions, and even, it is said, to steal the papers of the surveyors for rival projects.

The plans for projected railways were required to be deposited by the end of November, 1846; but as early as March the enthusiasm of speculators began to abate and anxiety to be felt. To sell any shares connected with new lines had become almost impossible at any sacrifice, and the only hope remaining to the majority of the holders was that the bills before Parliament might be thrown out, and that an account might be rendered of the unappropriated funds. In the opinion of some of the most experienced men on the Stock Exchange there was not a single new company in which the majority of shareholders would not vote for abandonment. This opinion had nothing to do with the merits of the respective undertakings, but arose from the persuasion that too much had been attempted at once, and that there was thus a too great and sudden drain upon the capital of the country.

But those who had not learnt by experience were not deterred by the experience of others. In the ensuing May, Mr. GEORGE HUDSON, M. P. for Sunderland, obtained the consent of shareholders to forty railway bills, involving an expenditure of about $50,000,000. His financial ability had enabled him to restore public confidence in railways not hitherto successful, and earned him the title of the "Railway King." He became chairman of numerous railways, and always contrived to pay good dividends; and the majority of shareholders were content to look at results without inquiring too closely how they were brought about. He proposed a testimonial to GEORGE STEPHENSON, the anticipated result being the getting-up of the Hudson testimonial, subscribers to which were allotted railway shares which could be sold at a premium. Such was his power that he could create paper wealth at a word, and his parliamentary influence was such that he could "walk quietly through Parliament with some sixteen railway bills under his arm." As early as April, 1846, the railways authorized that year represented an expenditure of over $450,000,000.

The tide was, however, already on the turn. Shares went rapidly down, and subscribers, many of whom possessed no capital, found themselves unable either to dispose of their shares or to meet the calls made upon their purses. Disappointed speculators of any class were not disposed to look leniently upon the faults or errors of those who had been instrumental in misleading them. Those who had failed to win, as well as those who had sustained losses, were ready to throw the blame due to their own rashness upon those whom they had blindly followed. Hence, when HUDSON once fell into disfavor, his disgrace and downfall were as rapid and ignominious as his rise had been extraordinary. In 1849 some of the railway companies began to institute inquiries into his conduct, and definite charges were brought against him from time to time in Parliament and elsewhere. He found it necessary to retire from several companies, in consequence of the suspicion with which he was now regarded, and actions were brought against him for the recovery of large sums alleged to have been misappropriated in railway transactions. The effects of the bursting of the bubble were felt for many years after.

The Connecticut Law Concerning Dams and Reservoirs.

In an editorial in our issue of Aug. 24, 1889, the laws regulating dams and reservoirs in Connecticut, Rhode Island and Massachusetts was very fully discussed. But, in view of the general interest in this topic awakened by recent events, we here reprint this Connecticut law in full, as enacted in 1878:

SEC. 3696. The member of the Board of Railroad Commissioners who is a civil engineer, and one civil engineer residing in each congressional district in this State, to be appointed by him, shall constitute a board of civil engineers, and have the supervision of all dams and reservoirs now existing or hereafter constructed in any locality where, by the breaking away of the same, life or property may be in danger of destruction.

SEC. 3697. The members of said board shall be sworn to faithfully and impartially perform the duties imposed upon them by this chapter, and shall continue in office for the term of two years and until others are appointed in their places and stead. They shall each receive $10 per day, and all necessary and reasonable expenses while actually employed in the business of their office, to be paid as hereinafter provided.

SEC. 3698. The mayor and aldermen of any city, the warden and burgesses of any borough, the selectmen of any town, or a majority of them, upon the application of two or more persons or corporations who would suffer loss or damage by the breaking away of any dam or reservoir within said city, borough or town, shall forthwith inspect the same, and if in their opinion said dam or reservoir is not sufficiently strong and substantial to withstand the action of water under any circumstances which may reasonably be expected to occur, they shall at once notify one or more of the board of civil engineers to inspect the said dam or reservoir with them, and if in the judgment of the said engineers said dam or reservoir is unsafe, they shall serve notice on the person or persons owning or having the care and control of the same, to place said dam or reservoir in a safe or permanent condition, under the supervision of one of the said board of civil engineers, and when such repairs are completed and accepted by said civil engineer, he shall issue a certificate to said owner or persons owning or controlling the same, and also cause to be recorded upon the records of the town in which said dam is located, his doings, with a copy of the certificate so issued; but if said engineer shall find said dam or reservoir to be secure and safe, then the expense of such inspection shall be paid by the town in which said dam or reservoir is located.

SEC. 3699. When any person or corporation purpose constructing a dam or reservoir in a locality where the life or property of any other person may be endangered through the insufficiency thereof, the plans and specifications for such dam or reservoir shall be submitted to any member of said board of civil engineers, who shall examine the ground where the dam or reservoir is to be built, and the plans and specifications therefor, and if he approve the same, he shall issue a certificate authorizing the construction of such dam or reservoir, and no such dam or reservoir shall be constructed without such approval and certificate.

SEC. 3700. The engineer under whose authority any dam or reservoir is being constructed, shall cause the work upon the same to be inspected at least three several times before its completion, and if he shall be satisfied that such dam or reservoir has been built in a substantial and safe manner, and in accordance with the plans and specifications approved by him, and is strong and secure he shall issue a certificate approving of the same, which certificate shall be recorded in the office of the town clerk of the town in which such dam or reservoir is located; and no such dam or reservoir shall be used until such certificate is obtained and recorded.

SEC. 3701 The compensation and expenses of the board of engineers, or any of them, when acting under the provisions of the three preceding sections shall be paid by the person or corporation owning or constructing the dam or reservoir.

SEC. 3702. The Superior Court shall have jurisdiction to render all judgments necessary to carry into effect the provision of this chapter.

WM. O. SEYMOUR, Ridgefield, Ct.,
T. H. MCKENZIE, Southington, Ct.
N. J. WELTON, Waterbury, Ct.,
B. H. HULL, Bridgeport, Ct.,
H. B. Potter, Norwich Town, Ct.,
State Board of Engineers.

The comments to be made upon this law are: (1) That the public is left to decide for itself when a dam is dangerous, and it is not made the duty of an engineer to periodically inspect them—as in Rhode Island; (2) when a dam is reported as dangerous by the State board of engineers, the power of this board ends with "serving a notice" for repairs upon the owners of the dam.

In the great majority of cases the sense of personal responsibility for future accident from a dam reported as unsafe is a sufficient incentive to at once put it in good repair, But there are many reckless and foolish men in this world, and it certainly should be in the power of the State to protect its citizens against the consequences of this recklessness or folly in the owner of a dam. This law assumes that the engineers constituting the State board thoroughly understand their business; and while they have the power to pronounce an existing dam unsafe, they should have the additional power of recommending its repair within a reasonable time, or of *compelling* its abandonment as a dam, and he letting out of all water impounded by it.

A legal provision of this kind would rarely need to be enforced; but its existence on the statute books would serve as a spur to the careless man in hastening necessary repairs, and prevent injury to the public from the continued existence of a dam which was pronounced unsafe, and which its owner or owners would not repair.

A sense of impending danger may be usually depended upon to give the alarm in case of a very dangerous dam, and also in the case of many only thought to be dangerous. But the periodical and careful inspection of every dam by a trained engineer is a much surer index of its real condition than public suspicion, and in this respect the Rhode Island law is superior to the Connecticut law here given.

A NEW EXPLOSIVE, invented by Mr. H. S. MAXIM, is described as follows: Gun cotton is first dissolved in acetone, ethylic acetate or some like solvent; nitro-glycerine or nitro-gelatine is then added with a certain quantity of castor oil and the whole well mixed. The resulting compound is forced through a perforated plate and comes out in threads, like macaroni. The castor oil toughens the product and decreases deterioration.

RAILWAYS.

EAST OF CHICAGO—Existing Roads.

Toronto Belt Line.—H. Carry, of 82 King St., Toronto, Ont., Chief Engineer, writes us as follows concerning this enterprise:

The road will consist of two loops encircling the cities of Toronto and West Toronto Junction. The total length of the line will be 17 miles, and of this 8¼ miles will be new construction. The work will be moderately heavy; maximum grade 3 per cent. and maximum curve 5°, with the exception of three 8° curves. The largest bridge will be a 66 ft. plate girder over a street crossing. The principal business of the road will be in city and suburban passenger traffic and suburban and local freight. It is expected that the line will be completed and opened for traffic by July 1. J. D. Edgar is President.

Grafton & Upton.—H. P. Bean, Chief Engineer, informs us that all but about 1,000 ft. of the track has been laid on this road from Hopedale to Milford.

Chicago & West Michigan.—Surveys have just been completed by this company for a branch from Traverse City to Carp Lake, Mich., about 9 miles.

Maryland Central.—A press dispatch from Baltimore, Md., contains the following concerning this enterprise:

"That the reorganized Maryland Central R. R. will soon become an important connection of the Philadelphia & Reading system is now an established fact. The work of constructing the 16 miles of road that will connect the Maryland Central with the Lancaster and Quarryville branch of the Reading is going on. The changing to broad gauge in improving the roadbed of the Maryland Central is rapidly approaching completion, and the new bridge across the Susquehanna will soon be built. Among the capitalists interested in the extension scheme are Alexander Brown & Son, bankers, of Baltimore; W. W. Spence, John H. Miller, of Pittsburg; George Jewett, President of the Deer Creek & Susquehanna R. R., and several prominent Philadelphia men. Mr. Jewett has recently had several conferences with the Maryland Central officials in this city. He proposes a plan for the extension of the Maryland Central lines to the Lehigh Valley road, near Bethlehem, Pa., which can be reached by the construction of 28 miles of railway in Pennsylvania. A like extension to a point near Coatesville, Pa., will reach the Wilmington & Northern R. R. From Coatesville the route extends to a crossing of the Schuylkill River about 8 miles south of Reading; thence by a line to be constructed it will reach a connection with the Lehigh Valley road near Bethlehem. Mr. Jewett says that such an arrangement would give to Baltimore a supply of anthracite coal from a new source and stimulate the coal trade of this port. The purchase of the York & Peach Bottom R. R. by the Maryland Central syndicate gives the latter an opportunity of entering into a sharp competition with the Northern Central R. R. between York and Harrisburg and Baltimore. By the consolidation of the York & Peach Bottom R. R. with the Maryland Central and the construction of the Deer Creek & Susquehanna road to connect with the Maryland Central, the Reading will have a short outlet to Baltimore from the coal fields.

Cleveland, Akron & Western.—This company is said to be considering the construction of its line from Akron, O., directly west to Findlay, O., instead of to Carey, as was first intended. The plan includes the purchase of the American Midland R. R., now completed from Findlay to Glandorf, O., and with a roadbed partly graded from Glandorf to Fort Wayne, Ind., John H. Semple, of Akron, O., is Chief Engineer.

Harrisburg & Potomac.—The Provident Life & Trust Co., of Philadelphia, as trustee, announces that it will sell on July 28 the property of this railroad company, whose tracks extend from near Bowmansdale to Shippensburg, Pa., a distance of 32 miles, to secure $507,200, which the corporation is alleged to owe the company on a loan of $1,800,000.

Michigan Central.—The people along the route are endeavoring to induce this company to extend its Michigan Midland Branch from its present terminus at Lennox, Mich., via. Romeo, Oxford, Goodrich, Atlas, Flint and Flushing, to Chesaning, Mich., a distance of about 90 miles.

Projects and Surveys.

Auburn, Ligonier & Chicago.—A press dispatch states that the surveys for this road will commence April 15. The road is projected to run from Auburn, Dekalb county, Ind., to Chicago, Ill. The Old Southern Canada route will be followed.

Ivorydale & Mill Creek Valley.—Incorported in Ohio to build a line of railway from Ivorydale to St. Bernard, with branches to Carthage and Madisonville. Among the incorporators are: Wm. A. Procter, H. F. Procter, David Gamble, and Harry W. Brown.

Hudson Bay Ry. & Navigation Co.—A press dispatch from St Paul, Minn., says:

Advices from Ottawa say that the Canadian Government has decided to guarantee the interest on $5,000,000 of the bonds to be issued by the Winnipeg & Hudson Bay Ry. & Navigation Co. for the construction of that road. Hugh Sutherland, President of the company, and representatives of the British capitalists who are ready to put their money into the scheme, are at Ottawa completing the arrangements. Years ago the company received a large grant in aid of the road, but failed to interest capital until the Norquay Government guaranteed the interest of several millions of its bonds. Before the act could be utilized, the Greenway Government returned to power and s cured its repeal. Since then the Government of Ottawa has been besieged, and a majority of the members of Parliament have been induced to sign a petition in aid of the road. The bill to guarantee the interest on the company's bonds will undoubtedly be passed at this session, and work will be resumed as soon as the weather will permit. There is a bill now pending in the Manitoba Legislature granting a subsidy of $750,000 for the building of a part of the road which passes through that province from Winnipeg northward.

SOUTHERN.—Existin Roads.

Chattanooga Southern.—The contract has been awarded for the construction of this road from Chattanooga, Tenn., to Gadsden, Ala., a distance of about 80 miles. Work has already been commenced.

East Tennessee, Virginia & Georgia.—It is stated that this company will soon commence work on an extension from Regersville to Big Stone Gap, Va.

Staunton & West Augusta.—E. C. Vincent, of Staunton, Va., Chief Engineer, will place three corps of engineers in the field as soon as the necessary men can be secured. He wants two level-men, two transit-men, and a topographical draughtsman. The road is projected to run from Staunton to the Dora coal fields, 25 miles.

Birmingham, Sheffield & Tennessee River.—This company has entered into a contract to build a line of railway to Chicasaw, on the Tennessee River. The road is to be completed in two months.

Tavaris & Gulf.—This is the new name of the Tavaris, Apopka & Gulf R. R., notice of the sale of which was given in our last issue.

Louisville & Nashville.—Right of way is being secured for the branch from Clarksville to Dickson, Tenn., 35 miles.

Wilmington, Onslow & East Carolina.—It is now expected that this line will be completed and in operation from Wilmington, N. C., to Jacksonville, N. C., by July 1. About four miles of the track have already been laid.

Columbia, Newberry & Laurens.—Tracklaying has been completed to within 10 miles of Prosperity, N. C. and will be completed to that place in about a month. By that time it is expected that the grading will be completed between Prospect and Newberry, and that tracklaying will continue without delay.

South Bound.—The Savannah Construction Co. has been organized to build this road from Columbia, S. C., to Savannah, Ga. Among the directors are: J. H. Parker, President of the New York Cotton Exchange, Frank S. Hambleton, B. Cohn, Charles Watkins, and others.

Queen & Crescent.—A press dispatch, dated April 1, states that this system of railways has been purchased by the Eastern Tennessee, Virginia & Georgia R. R. Co.

Projects and Surveys.

Millen & Southern.—This company has been organized in Georgia to take the place of the Rogers & Summit R. R. Co., operating a railway from Rogers to Stillmoore, Ga. The new company proposes to take up 9 miles of the track and change the northern terminus from Rogers to Millen, and to extend the road to Sterling, Ga.

Appling, Coffee & Irwin.—A press dispatch states that Charles Bewick & Co., of Detroit, Mich., are building a large saw mill at Hazlehurst, Appling county. It will have a capacity of about 200,000 ft. per day. They have in the neighborhood of Hazlehurst an immense body of land, and in addition they propose building a railroad a distance of about 40 miles through Appling, Coffee, and Irwin counties to Irwinsville. By this means they will reach an almost inexhaustible supply of the finest timber that grows in the south. They are to begin construction of the line right away, and it is their intention to complete about 28 miles of the road by next fall. They propose establishing a permanent line from Hazlehurst to Irwinsville. The line as surveyed will run directly through a magnificent timber belt, and one of the most productive sections of the country in south Georgia, from an agricultural point of view.

Charleston & Norfolk.—It is proposed to build a road from Charleston, S. C., to Georgetown, S. C., then on to Norfolk, either by way of Wilmington to Norfolk, Va., or the most direct line possible from Georgetown to Tarboro' and then to Norfolk. It would shorten the distance from Charleston to Wilmington about 70 miles.

Rome Mineral.—This company has been chartered in Georgia to build a railway from Rome to Ringold. It is stated that work is already in progress.

NORTHWEST—Existing Roads.

Chicago, Burlington & Quincy.—The annual report of this company for the year ending Dec. 31, 1889, shows the following results from operations as compared with the previous year:

	1889.	1888.
Gross earnings	$26,778,314	$23,789,169
Operating expenses and taxes	$17,690,547	$18,882,459
Net earnings	$ 9,087,765	$ 4,906,707

President Perkins in his preliminary statement says: "It is more and more apparent as time goes on that until the Interstate Commerce law is modified, we can not hope for a settlement of the rate troubles. The long and short haul rule, as interpreted, and the prohibition of pooling have been shown to be insurmountable obstacles to the satisfactory conduct of business. Slight modifications in the two provisions, while preserving all the people want, namely, just and uniform rates, would enable the roads with reasonable State laws to so regulate themselves as to give a fair opportunity for profit.

Burlington & Missouri River.—A press dispatch from Deadwood, So. Dak., reads as follows:

A force of 300 men and 40 teams was put to work to-day on the Burlington & Missouri road into Deadwood. Grading was begun at Pennington, just above Deadwood, and the work will be pushed up Whitewood Gulch as rapidly as possible, and out to connect with the Burlington at New Castle, Wyo. The Burlington & Missouri R. R. is the first road to penetrate the Black Hills to the rich gold mines and mills in the neighborhood of Deadwood.

Projects and Surveys.

Cass St., Lake View & Evanston.—Incorporated in Illinois to build a line of railway in the city of Springfield, Ill. Among the incorporators are: Hiram Burbee, Samuel W. Jackson, L. R. Hall, and H. H. Anderson.

St. Louis, Central & Western.—This company has been chartered to build a line of railway from the west bank of the Mississippi River, opposite East St. Louis, west to the north line of Forest Park. It is stated that work on construction will begin at once. Among the incorporators are: Geo. A. Baker, Geo. W. Parker, Henry L. Edmonds and G. L. Peabody.

Milwaukee Belt & Terminal.—Chartered in Wisconsin to build a belt line of railway around the city of Milwaukee. Among the incorporators are: Theo. B. Talbot of Brooklyn, N. Y., and J. S. Klein, of Milwaukee.

SOUTHWEST—Existing Roads.

Hutchinson & Gulf.—Arrangements have been completed for the early commencement of construction upon the further extension of this line. The road is now completed from Hutchinson to Kenyman, Kan., 32 miles. Edward Powers, of Delevan, Wis., is Chief Engineer.

Projects and Surveys.

Highland & St. Joseph.—Chartered in Kansas to build a line of railway from Highland to some point on the St. Joseph & Grand Isle Division of the Union Pacific Ry., near Ryan's Station in Doniphan Co. The principal offices of the company will be at Highland. The directors are: Chas. D. Haines, Elmer T. Haines, and Andrew G Haines, of New York City; Judson Kingsley, of Troy, N.Y., and Jas. S. Butler, Norman Case and L. L. Gilmore, of Highland.

Aransas Pass & Suburban.—Incorporated in Texas to build a line of railway from Corpus Christi to Aransas Pass. Among the incorporators are: F. Hamilton, J. R. Johnson, J. M. Maddox, and C. E. Anderson.

Kansas City, Nevada & Ft. Smith.—A. L. Howe, of Kansas City, Mo., Assistant Secretary, writes us that the survey is practically completed for this road. The line will be 170 miles along, and with the exception of the first 13 miles the work will be very easy, with light grades and easy curves. The route is through a country rich in minerals and timber, and these will furnish a large portion of the traffic for the road. E. L. Martin is President, and F. W. Bond is Chief Engineer; both of Kansas City, Mo.

Corsicana & Southeastern.—This road is projected to run from Corsicana, Tex., southeast about 45 miles to a connection with the International & Great Northern R. R.

ROCKY MT. AND PACIFIC.—Existing Road.

Port Townsend Southern.—Work is making rapid progress on this road, about 1,500 men being employed on the grading from Port Townsend, Wash., south. It is expected to have 20 miles of the line completed by Sept. 1, and 50 miles by Jan. 1, 1891.

RAPID TRANSIT.

Street Railways.—The East & West Ry. Co., of New York, has been incorporated by Lyman E. Minor, James A. Smith and Elijah L. Payne to build a line from Second Ave. and 129th St. to 150th St. and Harlem River, New York City. Capital stock, $300,000.

The Fulton, Wall St. & Cortlandt St. Ferries Ry. Co. has been organized to build a cross-town line on Pine, Liberty and Cortlandt Sts., New York City. President, Edward Kearney; Secretary, D. J. Apgar. Capital stock, $700,000.

The Corvallis St. Ry. Co., of Corvallis, Ore., has awarded the contract for the construction of its line to J. E. McCoy, of Salem, Ore.

The Tacoma Belt Ry. Co. has been incorporated at Tacoma, Wash., by Wm. H. Cushman, Fremont S. Harman and Allen B. Gresham. Capital stock, $30,000.

The East & West Washington Traction Ry. Co., of the District of Columbia, has been incorporrted by Hamilton

Disston, A. N. Bliss and James G. Berrett Capital stock. $500,000

The Waco Dummy St. Ry. Co., of Waco, Tex., will sell its road and equipment. The line is 10 miles long. For particulars address J. E Parker.

Electric Railways.—When the Willimansett bridge is built, an electric railway is to be built from Chicopee, Mass., to Holyoke.

The street railways at Williamsport, Pa., have been sold for $120,000, to a Philadelphia syndicate, which will put in an electric system.

The Duquesne St. Ry. Co., of Pittsburgh, Pa., has awarded the contract for 25 miles of electric railway to Booth & Flinn.

The National Electric Traction Co., of Detroit, Mich. has been organized to build electric lines on the Rae system.

At St. Louis, Mo., ordinances have been passed author. izing the overhead wire electric system on the following lines: Lindell system, 22 miles; Union Depot lines, 24 miles; Mound City, 7 miles; Benton & Bellefontaine, 8 miles; Missouri Ry. Co., 12 miles; Southern Ry. Co., 13 miles; Broadway & Seventh St., 6 miles; total, 92 miles. The amounts to be expended in improvements are as follows: Lindell, $1,250,000; Union Depot and Mound City lines, $1,600,000; Benton & Bellefontaine, $300,000; Missouri, $550,000; Southern, $400,000.

The West St. & North End Electric Ry. Co., of Seattle, Wash., has awarded contracts as follows: Piling, Howard & Bryant; timber bridging and trestling, Smart & Simpson; grading, O'Day & Co., 27 cts. per cu. yd.

Cable Railways.—The Lake Washington Cable Ry. Co., of Seattle, Wash., has been incorporated by Fred E. Sander, H. K. Hall and L. I. Burns. The company will acquire and improve the Yesler Ave. and Jackson St. line. Capital stock, $600,0 0.

The Metropolitan Ry. Co., of Dallas, Tex., will build three miles of cable railway, and will purchase plant for the same; four miles more will be built later.

Elevated Railways.—The Massachusetts Legislature, at Boston, has a committee on street railways which has been hearing considerable evidence on the elevated railway question. The following companies have applied for charters: People's Elevated Ry. Co ; Charles H. Nichols, J. C. Moore and Henry J. Bartlett. Boston & Suburban Elevated Ry. Co.; L. L. Tower and Daniel E. Chase, White Safety Elevated Ry. Co.; R. T. White. Boston Elevated Ry. Co.; Frank A. Bartholomew, Roland Worthington and Jonathan Dwight (Riley system). Mack Elevated Ry. Co.; Wm. B. Mack, Charles E. Wentworth and H. E. Russell (Mack system) Meigs Elevated Ry. Co. West End St. Ry. Co.

HIGHWAYS.

New Jersey.—Four more county roads are to be graded and macadamized in Union County. The quantities are approximately as follows : Bay Way and West Jersey St., 250 cu. yds. of excavation, 1,857 sq. yds. of macadam or Telford pavement. North Ave., 9,151 cu. yds. of excavation, 25,371 sq. yds. of macadam or Telford pavement. North Ave. and Eastman St., 6,456 cu. yds. of excavation, 20,847 sq. yds of macadam or Telford pavement. Morris and Springfield Aves., 3,000 cu. yds. of excavation, 14,117 sq. yds. of macadam or Telford pavement. For particulars address F. A. Dunham, Engineer of County Roads, Plainfield, N. J. Proposals will be received until May 1 by J. F. Hubbard, Director, Court House, Elizabeth, N. J.

Massachusetts.—The Hampshire County Commissioners have filed their formal decree for the new road and bridge to South St., at Northampton, making the location of the survey and awarding the land damages. A petition has been sent to the Supreme Court, asking for the appointment of special commissioners to go on with the work.

New York.—The Newburg & Ellenville Plank Road Co., of Newburg, after an existence of 40 years, ceased to exist by expiration of charter on April 5, and abandoned its claim on the roads, thowing them open to the public and doing away with the toll gates on its line. The company controlled 33 miles of road, constructed at a cost of $127,219. The road, for a number of years, paid a dividend ranging from 1 to 10 per cent., but for the last 10 years no dividends were earned.

Vermont.—If the legislature does nothing else next fall, it will be able to give no excuse for ever having had existence if it does not elect a superintendent of education who can superintend and also devise improved highway laws. It is the universal verdict of travelers that the roads of this State have degenerated rapidly during the past ten years. Of course, that is not the fact in every town, but probably it is not untrue of the most of them. Just how a better state of the roads is to be brought about at a price taxpayers can afford to pay is not so plain, but it is worth while to consider the advisability of enlarging highway districts from towns to counties. A county could profitably hire a specialist to supervise the work of building and repairing the roads, thus securing better results for the money and material expended. Beside, the general welfare, rather than the needs or desires of one or two individuals, might influence the expenditure; nor would a competent superintendent waste money by trying to fix 25 miles of clay road with $50.—*Middlebury Register.*

Indiana.—The toll road in Putnam Co., between Greencastle and Crawfordsville, has been appraised at $2,000 per mile, and the question of buying it will be submitted to the people at the next election.

Washington.—A law has been passed providing for laying out, opening, building and maintaining turnpike roads, and authorizing counties to issue bonds therefor. The power for doing this is invested in the county commissioners. Roads shall lead to the county seat, except it has more than 1,000 people by the last federal census. Roads shall be between 40 and 60 ft. wide. No tax shall be levied for road purposes except with the consent of three-fifths of all votes cast at a special election. No tax shall be levied on land previously assessed for free turnpikes. Bonds issued shall bear not more than 6 per cent. interest and must be issued for not more than 20 years. Three-fifths of the votes must consent to such issuance. Approved March 7, 1890. Also a law authorizing county commissioners to create road districts and keep highways in repair, for which a tax may be levied. An annual road poll tax of $2 is required. Approved March 7, 1890.

WATER-WORKS.

NEW ENGLAND.

Bethel, Me.—Mr. Jordan, of Auburn, Me., has been looking over the location and making estimates for the Bethel Water Co. The Village Corporation is to pay an annual rental of $800 per year for 25 hydrants, to be located within the village corporation.

Cape Elizabeth, Me.—It is now reported that the selectmen have been authorized to make and execute a contract with the water company, for the introduction of Sebago Lake water, at a meeting to be held on April 14.

Eden, Me.—Samuel N. Riche, of Salisbury Cove, has sent us the following information:

The estimated cost of the works projected by the Eden Water Co. is $250,000. Water would be conveyed by gravity from Eagle Lake. John T. Higgins, of Bar Harbor, Me., is an officer of the company. Popul tion, 600.

Bath, Me.—Arthur Sewall and others have nearly consummated the purchase of the Bath Water-Works, and will take possession the last of the month.

South Wolfborough, N. H.—The Wolfborough Water Co. will probably extend its mains to, and supply the town with water.

Newton, Mass.—Sealed proposals will be received until April 25, for furnishing, and setting up complete. a pumping plant, consisting of pumping engine and boilers, if necessary to operate the same, which shall be capable of pumping respectively 5,000,000, and 3,000,000 United States galls. of water in 24 hours from the Newton pumping station to its proposed new reservoir. Said pumps to give a minimum duty of 100,000,000 ft. lbs., and said boilers to have a minimum evaporative efficiency of 11 lbs. per pound of combustible. General specifications and form of contract can be obtained at the office of Albert F. Noyes, City Engineer, City Hall, West Newton, Mass.

Methuen, Mass.—James A. O'Neill, of Indianapolis, Ind., has made the town a proposition to establish works. [A small system, for fire protection only, was put in by the village in 1876.—ED.]

Worcester, Mass.—Water Commissioner John G. Brady informs us that the following improvements will be made:

Laying about 13,000 ft. of 6-in., 4,000 ft. of 8-in. 3,000 ft. of 12-in. pipe; and relay in place of old cement-lined pipe, about 12,000 ft. of 6-in., 4,000 ft. of 8-in., 4,000 of 12 in., and 3,000 ft. of 16-in. pipe. Also set about 100 hydrants. Of this number 60 will be new, and 40 to replace flush hydrants. About 50 new valves, and between 500 and 600 new meters will be placed.

Winchester, Mass.—A citizens' committee will report in April upon the question of appropriating $60,000 for improvements, requested by the Water Board, and also upon the work done on the reservoir of the Highland works.

Lenox, Mass.—Sealed proposals were received on April 8 for constructing two reservoirs.

Taunton, Mass.—The Water Commissioners are to have $30,000 with which to purchase a new engine and boiler for the pumping station.

Winchester, Mass.—Superintendent W. T. Dotten informs us that about 5,000 ft. of 6 and 4-in. pipe will be laid, and about 3 new hydrants and 6 valves will be set this season.

Lenox, Mass.—Treasurer William D. Curtis has sent us the following:

About 4½ miles of 8 to 3-in. pipe will be laid this season, and about 10 new valves will be set. The contract for constructing two new reservoirs and laying the pipe has been awarded to Marsh & Blood, of North Adams, Mass.

MIDDLE.

Ithaca, N. Y.—The dam of the upper reservoir of the water company, holding 20,000,000 galls., burst on April 5. Two bridges were washed away, and considerable damage to other property was done.

Amsterdam, N. Y.—The Water Commissioners have resolved to make no improvement to Little Round Lake this year.

Gravesend, L. I., N. Y.—A certificate of incorporation of the Kings Co. Construction Co. has been filed with the Secretary of State. Its objects are to conduct and prosecute the business of boring, sinking and digging for, accumulating and storing water; conducting, selling, furnishing and supplying the same to cities, towns and villages, and their inhabitants, for mining, domestic, manufacturing, municipal and agricultural purposes; acquiring, leasing and conveying lands, waters, water power and privileges; laying out and maintaining reservoirs, conduits and pipes suitable for those purposes. The capital stock is to be $10,000. The incorporators are Benjamin F. Stephens, John A. Bramard and Allen W. Brainard, Jr.

Norwich, N. Y.—Engineer W. S. Franklin informs us that the following bids were received for constructing the new reservoir :

Adam Miller, Saratoga, N. Y., $59,630.78 ; Flood & Monty, Sandy Hill, N. Y., $51,036.54; Jebiel Vaughn, Stamford, N. Y., $50,413 73; Troy Public Works Co., Troy, N. Y., $42,180.70.

The contract was awarded to the Troy Public Works Co., of Troy, N. Y.

Rochester, N. Y.—Senator McNaughton and Mr. Courtney have introduced a bill into the Legislature authorizing the issue of bonds for the new water supply. The following resolution, adopted by the combination committee, has been passed by the City Council:

That it is the sense of this meeting that, while metering is necessary it will not prevent the need of constructing an additional all gravity conduit of 15,000,000 galls. capacity as soon as an enabling act can be passed, and we recommend to the Common Council that such an act should be at once prepared by the City Attorney.

Aldermen Selye and Thayer are members of the committee appointed to investigate the meter question.

Syracuse, N. Y.—The bill allowing the city to take its water supply from Skaneateles Lake has been reported upon favorably by the Committee in Executive Session.

Ellicottville, N. Y.—The stockholders of the proposed system of works have organized. Work will be begun as soon as possible.

Plainfield, N. J.—It is reported that Councilmen Newhall, Ruhsmore and Dunham have been appointed a committee to have control of the new works.

South Orange, N. J.—The Board of Water-Works Trustees will receive proposals for a water supply until April 30 Address H. H. HART, Chairman Water Committee.

Rochester, Pa.—Several officials of the proposed new water company have presented a proposition to the City Council offering to furnish 50 water plugs, to be used only in case of fire, at a cost of $40 per plug, per year, also three drinking places free of charge and a sufficient pressure all over the town. A committee was appointed to investigate and report at a special meeting on April 11.

SOUTHERN.

Winchester, Va.—The Equity Improvement Co. has been organized to build works. It proposes to invest $1,000,000 of capital stock in this and manufacturing plants. President, John Handley, of Scranton, Pa.

Radford, Va.—It is reported as probable that works will be constructed by B. C. Washington, of Charlestown, W. Va. Address J. D. Peters, Mayor, for information.

Portsmouth, Va.—A small amount of 6-in. pipe will be laid. G. H. Coleman is Superintendent.

Roanoke, Va.—Superintendent F. T. Brinkley has sent us the following:

Between 6 and 7 miles of new pipe will be laid this season. A duplicate engine and pump will be erected, and 20 new hydrants, and 60 to 80 new valves will be set.

Martinsburgh, W. Va.—A small amount of 6-in. pipe is now being laid. Superintendent, J. M. Shaffer.

Reidsville, N. C.—A citizens' vote will be taken on April 14 to decide the question of constructing works.

Fayetteville, N. C.—L. C. Wolkins, 95 Arch St., Philadelphia, Pa., President of the Southern Engineering & Construction Co., will build works. The company is reported to have a capital of $2,500,000.

Anderson, S. C.—Roddy & Whitner are the contractors for the new works, to be completed by July 1.

Aiken, S. C.—From investigations which have been made, it is thought that a daily supply of 75,000 galls. can be secured from springs near the town.

Charleston, S. C.—The improvements to the company's plant this year will consist of the laying of about 5 miles of 14 to 4 in. pipe, and setting about 100 new hydrants, 30 new valves, and 10 meters. Nearly all of this work has been completed.

Athens, Ga.—W. Howell, P. O. Box 2,640, New York City, President of the Athens City Water-Works Co., informs us that the following improvements will be made this year:

Laying about one mile of 10 and 8-in. pipe, setting 10 or 12 new hydrants, 4 to 6 new valves, and 10 to 20 new meters.

Savannah, Ga.—The question of increasing the water supply is being actively discussed. As a means of temporary relief it has been proposed to construct a reservoir, to be fed by a conduit into which the water will flow by gravity, cutting the casings to a depth which will permit the overflow into the conduit, and pumping direct from the reservoir into the mains. It is believed that this plan will supply all the water that the big pump can accommodate.

Alderman McDonough, Chairman of the Water Committee, has recommended to the City Council that the pumping capacity be increased as well as the mains, and that new wells be sunk, and that a new stand-pipe be erected. His recommendation was referred to the committee of the whole.

Albany, Ga.—Address Mayor T. N. Woolfolk for information regarding supplies, etc., wanted for building works.

Dawson, Ga.—An ordinance authorizing the building

of a system of works, under franchise, has been passed, providing that a system of works shall be put in operation within 18 months The city will take no part in the matter unless the parties to whom the franchise has been granted refuse to accept it, in which case the works will will be built by the city. W. B. Cheatham is Mayor.

Fort Valley, Ga.—W. H. Harris, Attorney, solicits correspondence with water-works contractors, and has sent us the following:

Propositions for constructing different systems are wanted. The town is desirous of letting the contract at once. Water is 8,000 ft. distant, and 125 ft. below level of town, and must be elevated 200 ft. A sufficient supply is wanted for 3,000 inhabitants and a few factories. No system has yet been adopted.

Opelika, Ala.—Address Mayor John T. Renfro for information regarding the projected works.

Bessemer, Ala.—Secretary and H. M. McNutt informs us that about two miles of new mains will be laid, and that 25 new hydrants will be set.

Greenville, Ala—It is reported that the citizens are desirous of having a system of works constructed. Address Mayor McMullan.

Sheffield, Ala.—Propositions are wanted for putting in a complete system of works. Address C. J. Voorhees, Chairman of the Water Committee.

Columbia, Ala.—The town is anxious to construct works, but has not got the money on hand with which to do the work. It therefore desires to make a contract with some reliable firm to construct works, the town to pay a yearly rental until the cost is paid, the works then to be the property of the town. The town now has an artesian well, pump, and boiler, and wishes to erect a tank 80 ft. high, and lay mains. Address M. S. Smith, Mayor.

Canton, Miss.—Work will soon be commenced on the artesian well.

Nashville, Tenn.—Superintendent George Reyer informs us that the amount of new pipe to be laid has not been decided upon, but that about 50 new hydrants and 25 new meters will be set. The number of valves that will be needed has not been determined.

Cleveland, Tenn.—H. Hungerford, of New York, is interested in the projected works.

McMinnville, Tenn.—It is reported as probable that J. M. Burger, to whom a franchise was granted some ago, will let the contract for building the new works. Water will be pumped to a stand-pipe.

Franklin, Tenn.—P. E. Cox has sent us the following

A proposition has been received to put in 40 hydrants for fire protection, and erect a plant, if the city will grant a franchise. Water would be pumped from a creek to a stand-pipe or reservoir. Population, 3,000.

Louisville, Ky—It is reported that a new pumping plant having a daily capacity of 16,000,000 galls. will be erected.

NORTH CENTRAL.

Cleveland, O.—A permanent injunction has been allowed preventing the water-works trustees from entering into a contract with the Lake Shore Foundry Co.

Sidney, O.—Contracts will be let within 60 days for furnishing about four miles of water pipe, 35 hydrants, etc.

Norwalk, O.—The proposition to bond the city for $75,000 has been defeated.

Martinsville, Ind.—The Board of Trade have offered a resolution favoring the immediate establishment of a system of water-works adequate to the present needs of the city.

South Bend, Ind.—Pumping machinery will probably be purchased and erected this season.

Monroe, Mich.—The question of the city purchasing and controlling the water-works was defeated at the election held on April 7.

Coldwater, Mich.—A majority vote of over 300 has been cast in favor of issuing $70,000 of bonds for establishing works.

Carlinville, Ill.—The new works were satisfactorily tested on April 2.

Chicago, Ill.—Press dispatches state that the crib to the new water tunnel has been partially destroyed by the recent heavy storms.

Pecatonica, Ill.—The new works are being constructed for the town by the Rockford (Ill.) Construction Co. They will be completed about June 1. Estimated cost, $10,000. Water will pumped from a well to a stand-pipe.

NORTHWESTERN.

Oskaloosa, Ia.—It is reported that new wells will be sunk. Also that new boilers will be purchased.

Leeds, Ia.—(A suburb of, and P. O. is at, Sioux City, Ia.).—Information regarding the projected works, mentioned in our issue of April 5, can be obtained from William Gordon, of Sioux City, Secretary of the Leeds Land & Improvement Co.

Litchfield, Minn.—The contract for constructing a system of works, with a 100-ft. stand-pipe, the supply to be furnished from drive wells, and 2¼ miles of mains, has been awarded to Fairbanks, Morse & Co., of St. Paul Minn., at $19,000.

West Duluth, Minn.—The Town Council has granted a 30 years' franchise to the West Duluth Land & Water Co. to establish works. The franchise specifies 5 miles of mains, 2 miles of which shall be laid before Dec. 31. The town will pay $80 per hydrant per annum for 80 hydrants or less, and $75 per year for each hydrant above that number. F. W. Payne, Ralph Marble, H. B. Moore and others, all of Duluth, are interested in (probably directors of) the company.

McPherson, Kan.—The proposition to sell the existing works to the Union Water Supply Co. has been carried by a citizens' vote. The present system is inadequate to the demands of the city, and it is probable that, practically, a new plant will be put in by the company.

Loup City, Neb.—The citizens have voted bonds to the Loup City Water & Improvement Co.

Hay Springs, Neb.—The town has voted to issue $5,000 of bonds for constructing works. S. Dewey, R. Reed, J. C. Johnson and others are the Town Trustees.

Hooper, Neb.—Works are being built.

Chamberlain, So. Dak.—A company is negotiating with the city for the purchase of the works.

Dana and Hanna, Wyo.—Plans for a water system for these towns have been agreed upon. The water is to be taken from Elk Mountain. Thirty miles of pipe will be required. The mains will be 12, 10, 8 and 6 ins. in diameter. Two large reservoirs, one for Dana, the other for Hanna, will receive the water for the general supply. From the source of supply to the reservoir the water will thave a fall of 500 ft. Work will be commenced on the pipe line in about three weeks. The systemis to be constructed by the Union Pacific Ry. Co. at an estimated cost of $200,000.

SOUTHWESTERN.

Brunswick, Mo.—We have received the following official information:

The Brunswick Water-Works Co. will construct works. Louis Benecke is President and Manager. No estimate of the cost can be made as yet, as the plans are not entirely agreed upon. The supply will be taken from artesian wells or the Grand River. Population, 2,000.

Lebanon, Mo.—The officers of the Lebanon Water Co. are: B. F. Hobart, President; J. E. Faulkerson, Secretary.

Monroe City, Mo.—George W. Tompkins has kindly sent us the following:

The Board of Trade and the Board of Aldermen are discussing the question of constructing works. A proposition is before the Board of Aldermen to purchase land for the lake, and let a private company construct the works. Surface water will furnish the supply, which will probably be pumped to a stand-pipe. Estimated cost, $10,000. Samuel J. Nelson can furnish information. Population, 2,000.

Helena, Ark.—The Helena Gas, Water & Power Co., has contracted with the Carlos Well Co., of Memphis Tenn., to sink two 1000-ft. 8-in. wells.

Hot Springs, Ark.—Bids will be received until April 20 by John W. Noble, Secretary of the Interior, Washington, D. C., for erecting an engine-house and impounding reservoir, furnishing pumping engines and boilers, cast and wrought-iron piping, special castings, fittings, valves, etc., and for excavation and performing the work necessary to complete the pumping station on the Hot Springs Reservation, at Hot Springs, Ark.

Dallas, Tex.—Press dispatches state the dam at the unfinished city works, above the city, has broken, and that the new $30,000 pumping engine is 100 ft. under water. The unfinished reservoir has also been seriously damaged.

Taylor, Tex.—New boilers to be put in.

Luling, Tex.—Work will be commenced at once. Prices for the following supplies are wanted by John Dochard, Superintendent:

Stand-pipe, 12 ft. in diameter by 100 ft. high, one mile of 8-in., and 2 miles 4-in. cast-iron pipe, medium weight; a pump of 200,000 galls. capacity per 24 hours, and about 2 miles of 2-in. wrought-iron pipe and all smaller sizes.

Abilene, Tex.—Sealed bids are invited for boring an artesian well to the depth of 2,500 ft. if required; well to be not less than 6 ins. at the bottom. Bids will be opened and considered on June 20. The right is reserved to reject any or all bids. Address Henry Sales, Chairman Artesian Well Committee.

Boulder, Col.—Work is to be commenced as soon as pipe, specials, etc., can be secured. Address Alderman E. J. Temple.

Rico, Col.—The Town Board at its last meeting voted an appropriation of $11,000 to be used for improving the water-works by building a new reservoir, etc.

PACIFIC.

Anacortes, Wash.—The new works will be put in operation about May 1.

Cheney, Wash.—Water bonds for building works have been sold. Pipe-laying will be commenced at once.

Portland, Ore.—The question of laying a large cast-iron main in Front street is being discussed. About 1,524 tons of pipe would be required. The estimated cost is $100,000.

Los Angeles, Cal.—The Sierra Madre Water Co. hast filed articles of incorporation. The directors are J. DeBarth Shorb, Emanuel L. Stern, Tom J. Weldon, Walter G. Hughes and Herman Silver. The capital stock is $5,000,000.

Fresno, Cal.—W. P. McMurtry, President of the Fresno Water-Works Co., has sold the entire plant to the Mnnicipal Investment Co., of Chicago and London, for $500,000. The water supply is derived from eight wells, from 150 to 530 ft. deep, which yield 5,000,000 galls. per day. The present consumption is 1,530,000 galls. per day. The first payment of $100,000 has been made to Mr. McMurtry.

Redding, Cal.—The Citizens' Water Co. filed articles of incorporation. The directors are: Henry Bergh, O. J. Lawry, Fred Grotefenn, H. F. Johdson and Nathan Breslauer. The capital stock is increased to $200,000.

Salt Lake City, Utah.—Witcher Jones and associates have made a proposition to the city to purchase the existing works.

PROJECTS.

Hallettsville, Tex.; R. B. Allen.—Carman, Ill.; Simon Grant, Mayor.—Milledgeville, Ga.; F. S. Walker.—Belvidere, Ill.; T. B. Sands.—Richmond, Ga.—Portland, Ind.—Sullivan, Ind.; James M. De Camp, City Clerk.—Noblesville, Ind.; J. F. Neil, Mayor.—New Canaan, Conn.; Lewis B. Sutton.—Westport, Conn.; W. J. French, Town Clerk.—Princeton, Ind.; W. R. Creswell.—Jasper, Fla.; C. B. Tompkins.

ARTESIAN WELLS.

Waynesboro, Ga.—R. J. Edenfield, of Chauncy, has been awarded a contract to sink a well for the Steele Lumber Co.

Meeker, Colo.—The well has reached a depth of 520 ft.

IRRIGATION.

Ogden, Utah.—Sealed proposals will be received until April 17 for the excavation of two lateral canals, west of Bear River, in Box Elder County, Utah. The two canals will be 40 miles in length, and will require the excavation of about 1,000,000 cu. yds. of material. Elwood Mead is the Consulting Engineer.

Inyo, Kan.—The Owens Valley canal has been completed. It is 30 miles in length, and carries 7,500 miners' ins. Work was begun in June, 1887.

Colusa, Cal.—E. W. Jones has been elected a director of the Colusa Irrigating District.

Modesto, Cal.—The election of officers for the Modesto Irrigation Co. has resulted as follows: Directors, G. D. Wooten, F. Cressy, A. G. Carver and W. H. Finley.

Turlock, Cal.—The Turlock Irrigation District has elected the following Directors: E. V. Cogswell, R. M. Williams, J. W. Mitchell, Miller McPherson, Hubert Dunn; Assessor, O. H. Muncey; Collector, J. B. Osborn; Treasurer, C. N. Whitmore.

Topeka, Kan.—Eastern capitalists have awarded the contract for building the Amazon irrigating ditch, which will run through the counties of Finney and Haskell. It will have its source near the head of the Arkansas River. It will be 35 ft. wide, 6 ft. deep. It is designed to empty first into what is known as the "Big Basin," and northwest of Santa Fé into a natural basin, having a capacity of several millions of gallons. The ditch will be fed by basins from water stored in these reservoirs during the rainy season.

SEWERAGE AND MUNICIPAL.

Houston, Tex.—The city has recently let several large sewer contracts, aggregating over $100,000, on plans and specifications prepared by G. W. Kiersted, M. Am. Soc. C. E, of Kansas City, Mo. The system as designed has an aggregate length of 70 miles. The "separate" system is chiefly used, with an occasional combined sewer to relieve certain districts of storm water. Separate and independent storm conduits of a shallow depth discharging into the nearest water course are occasionally employed to relieve surface drainage. The town site being exceedingly flat the sewers have usually a light grade. Provision is consequently made for flushing by flush-tanks and roof water admitted at the summit of laterals. The execution of plans is under the supervision of Mr. Kiersted.

Sewerage.—At White Plains, N. Y., after hearing the report of the Citizens' Committee relative to the cost of lowering the sewer disposal works and outlet sewer pipe, the taxpayers directed a committee to request the Board of Trustees to have the works and pipe lowered so as to dispense with the use of a siphon, providing the cost will not exceed $12,000.

At Baltimore, Md., an ordinance has been introduced nto the City Council to appropriate $112,000 for the construction of the sewer on Light St. For particulars address the mayor.

Mr. Andrew Rosewater, C. E., of Omaha, Neb., recently made an informal examination and statement upon the sewerage of Knoxville, Tenn. He recommended pipe sewers. He thought from what he had observed and from hurried calculations he had made upon facts furnished him by the city engineer as to the grades to be obtained, that the cost for mains would approximate $10,000 per mile that of the laterals half that, or a total something like $7,000 per mile on an average.

At Savannah, Ga., the City Council has passed a resolution that the city engineer be authorized to prepare specifications for the Bilbo Canal sewer as outlined by the plans now before council, and advertise for bids, to be received by April 15, 1890, for the construction of said sewer; he work to be completed within 90 days from date of award of contract; all excavation to be done prior to May 1, 1890.

The contract for sewerage at Fort Payne, Ala., has been awarded to Donahue & Nolan, of Chattanooga, Tenn., at $27,460. Work will be started at once.

A bill has passed the Ohio Senate providing for the appointment of non-partisan sewer commissioners at Springfield, O.

The sewerage system of Waco, Tex., is to be extended 10 miles. For particulars address the mayor.

Street Work.—The Mayor and Commissioner of City Works, of Brooklyn, N. Y., have decided to have granite paving laid on several streets at a cost of $290,000. The amount available for this work during the year is $1,000,000.

The Paving Commission, Troy, N. Y., will soon advertise for proposals for street work.

The Highway Committee, Reading, Pa., recently visited Philadelphia and Baltimore to study the methods of paving in vogue in those cities, especially asphalt and Belgian blocks, concerning the respective merits of which there is considerable controversy in Reading.

At Baltimore, Md., the city council has appropriated $12,000 for Belgian block paving on Courtland St.

At Moundsville, W. Va., proposals for 25,000 sq yds. of paving will be received until April 16 by L. G. Brock.

The Board of Public Improvement, St. Louis, Mo., has let contracts as follows: Cedar block paving, G. Eyermann, Jr.; granite block paving, Stifel & Ruckert and J. A. Schneider. Grading and paving alleys, Skrainka Construction Co., and G. Eyermann, Jr.

At Nebraska City, Neb., an ordinance has been passed providing for the issue of bonds for curbing and guttering in Paving District No. 2.

At a recent meeting of the City Council at Seattle, Wash., about $20,000 worth of work for street grading was ordered, and about 20 new streets were ordered graded. City Engineer Scurry has the plans almost ready for the letting of contracts, which he estimates will give steady employment to at least 500 men this summer.

Drainage.—Maj. R. A. Blanford, of Savannah, Ga., has made a profile of the Little Ogeechee pond or reservoir, which feeds the Ogeechee canal, showing that the proposed plan of making the Ogeechee canal an auxiliary to the county drainage would reclaim from 8,000 to 9,000 acres of land now valueless, but which is said to be very rich. He expresses the belief that if the Ogeechee canal is deepened, a sluice way is made to relieve the backed-up waters of the Little Ogeechee, permitting them to find their way into the natural channel of the river, and drain Harden swamp, and the culverts are enlarged to accommodate the water which should pass through them, that the canal could continue to be used for purposes of navigation. To carry out a drainage plan of this kind, Maj. Blanford says would cost approximately $40,000. By the plan proposed Harden swamp on either side of the Ogeechee canal could be drained into the canal. It is said to be the purpose of the County Commissioners to relieve that portion of the county of its waters, and this the county will seek to do first through the co-operation of the canal company.

ELECTRICAL.

New York City.—Bids for gas and electric lighting for the city for another year were opened this week by the Gas Commission at the Department of Public Works. For gas lighting, the bids were as follows: New York Mutual Co., $17.50; Consolidated Co., $17.50; Equitable, $12, the price being limited by the company's charter to this figure; Central Co., $27, and the Northern and Yonkers, $28 per lamp each. The three last-named companies do business entirely in the annexed district. For lighting Woodlawn Heights with naphtha, the New York & New Jersey Globe Co. asked $22.50 per lamp. The bids of the electric light companies exhibited a uniform advance in the prices demanded over last year. Representatives of the companies present declared that the increase was made necessary by the increased cost to them of the subway system of conduits. The United States Co. bid for 314 lamps at 39, 41 and 42 cts. per night each. The Brush Co., for 337 lamps, asked the same prices. For 175 lamps the Mount Morris Co. asked for part 39 cts. and for others 42 cts. The Harlem Lighting Co. wanted 39 cts. per night for 166 street lamps and 50 cts. for 19 lamps in Mount Morris Park. The East River Co. asked 42½ cts. for 226 lamps. The total number of lamps bid on is 1,237, or 109 less than last year, the cutting down of the wires having removed that many. The prices are about 15 per cent. higher than those of last year.

Electric Lighting.—At Greenfield, Mass., the select. men have been authorized to make a contract with the electric light company for five years.

At Northampton, Mass., John F. Lambie has made a proposition to the Street Lighting Committee to light the streets with lamps of 2,000 c. p., the number to be the same as at present, at $60 per light for the first year, $55 for the second and third years, $50 for the fourth year, and then to turn the plant over free to the city at the fifth year, or to continue lighting thereafter at $37.50 per light. The plant is to be run by water power.

The Thomson-Houston Electric Co. will establish an electric light plant at Gallatin, Tenn., to furnish 60 lights of 1,200 c. p. each, at a cost of $1,000.

At Milwaukee, Wis., the Milwaukee Light & Power Co. has been incorporated by J. J. Kempf, W. H. Earles and Chas. Stolper. Capital stock, $500,000.

Roddey & Whitner, engineers and contractors, have been awarded the contract for lighting the city of Anderson, S. C., for 10 years; they also have the privilege of furnishing the citizens with lights and electricity for power. A plant will be put in by July 1, to be operated in connection with the water-works. Incandescent lights will be used altogether.

The Union Electric Light & Power Co. has been incorporated at Union, Ore., by J. W. Shelton, W. R. Hutchinson and R. W. Purdum. Capital stock, $100,000.

W. M. Blount, of Bainbridge, Ga., wants proposals for putting in a plant for 300 incandescent lights of 16 C. P.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—*South Casselman, Ont.*—Sealed tenders will be received until May 20 for the construction of an iron bridge across Nation River at this place. The bridge is to be 320 ft. long, with 16 ft. roadway, supported on masonry piers. Address O. Quenneville, South Casselman.

Buffalo, N. Y.—City Engineer Mann has prepared plans for the proposed bridge across Scajaquada Creek on Elmwood Ave. One plan calls for a stone arch bridge with masonry retaining walls, to cost $100,000. The other plan calls for a stone arch with earth embankments, the cost to be $60,000.

Niagara Falls, N. Y.—A bill has been introduced into the New York State Legislature to incorporate a company for the construction of a new bridge for railway or other purposes across the Niagara River at some point between the reservation at the falls and the old suspension bridge, near Lewiston. The capital stock of the company is to be $500,000, and may be increased to $2,000,000, in $100 shares. There are to be nine directors. The company is to be subject to the restrictions and liabilities of railway companies, and may issue bonds on loans not to exceed $2,000,000. It may also charge such compensation as may enable it to pay working expenses, interest on borrowed money, dividends of not more than 10 per cent., and such additional sums as will furnish a sinking fund each year not to exceed 5 per cent. of its bonded debt. If the bridge is not begun before July 1, 1895, and completed within five years thereafter, the corporation shall cease.

Rochester, N. Y.—The following bids were received April 4 for building the Platt street steel bridge at this place:

Wrought Iron Bridge Co., Canton, O	$123,343
Berlin Iron Bridge Co., East Berlin, Conn.	119,786
King Iron Bridge & Mfg. Co.	119,256
Rochester Bridge & Iron Works	118,010

The contract was let to the Rochester Bridge & Iron Works, whose detailed bid was as follows:

Excavation (882 cu. yds. at 98 cts.)	$864.36
First-class masonry (632 cu. yds. at $24.25	15,326.00
Second-class masonry (1,069 cu. yds. at ($12(	12,8 8,00
Concrete 97 cu. yds. at $6	582 000
Iron (1,538,837 lbs. at 5½ cts.)	84,638.03
White oak plank (72,901 ft., board measure, at $34.75 per M)	2,536.44
White pine plank (41,245 ft., board measure, at $30 per M)	1,237.35
Total	$118,010.18

The bridge is 858 ft. long, and consists of four spans, 158 ft. each, one span 126 ft. and four pier spans 25 ft. each. There will be a 22 ft. roadway and two sidewalks 8 ft. wide each. The structure will require 1,539,000 lbs. of iron, 73 000 ft. of white oak, and 41,200 ft. of pine. The work is to be completed by Nov. 30, 1890.

Baltimore, Md.—An appropriation of $250 has been asked for in the City Council to have plans and estimates prepared for a bridge on Monroe street over the Baltimore & Ohio, Baltimore & Potomac, and Western Maryland railroads.

Sutton, W. Va.—The Elk River Bridge Co. will build a 400-ft. bridge across the Elk River at this place.

Cincinnati, O.—The King Iron Bridge & Mfg. Co., of Cleveland, O., have the contract for building a high bridge over the Ohio River between the cities of Cincinnati and Newport. The bridge will be about 3,000 ft. in length, and include a cantilever span, with a clear waterway of about 520 ft. Bids are now being received on the foundation work. This company also has the contract for the iron work for about one mile of elevated road at Sioux City, Ia., besides a number of other bridges of more or less importance.

Augusta, Ga.—A press dispatch says: Ernest Groesbeck and M. J. Verdery, of New York city; W. H. Cozart, and others, of Augusta, have purchased about 6,500 acres of land opposite Augusta, and contemplate making extensive improvements, including the construction of an iron bridge across the Savannah River.

Macon, Ga.—There is talk of forming a company to build a bridge over the Ocmulgee River at Second St., Macon, Ga.

Birmingham, Ala.—An effort is being made to secure the construction of a $5,000 bridge over the railways at Twentieth St. Address the Mayor.

Duluth, Minn.—The Board of Public Works has received plans from Alfred P. Boller, of New York for the proposed drawbridge over the ship canal. The plans call for a steel structure, resting on a central pier to be sunk on the north side of the canal, just east of Lake Ave. The bridge is to be 475 ft. long over all, with the draw 200 ft. wide, or the width of the canal. The plans call for railway tracks in the middle of the bridge, footpaths on either side of the tracks and wagon roads on either side. There are three arches in the approach to the bridge. The height will be 20 ft. 6 ins. above the canal. The road grade is maintained 100 ft. at either end of the draw, then slopes off on a 4 per cent. grade, running under the railroad near Oak St. on the south and near Morse St. on the mouth of the canal. The bridge will carry two 80-ton locomotives, followed by a train load bearing 3,000 lbs. to the lin. ft., and the highway 500 lbs. to the lin. ft. It is estimated that the structure will cost $400,000.

Lakeside, Minn.—Bids for the construction of two trestle bridges at this place are asked for. Address S. L. Rice, Room 521, Chamber of Commerce Building, Duluth, Minn.

Pine Bluff.—The Pine Bluff Pontoon Bridge & Turnpike Co. has been chartered to build a pontoon bridge across the Arkansas River at this place.

Denison, Tex.—The Red River Bridge Co. has been incorporated by B. F. Colbert, W. B. Newman, L. L. Maughs and others to build a bridge over the Red River at this place.

Salem, Ore.—At the city election held March 31 this place voted $20,000 of bonds in aid of the proposed bridge across the Willamette River. It will probably be of steel, and bids will be asked at once.

Proposed.—Bridges are proposed at St. Michaels, Md., Vienna, Md., Dublin, Ga., Forest City, South Dak., and North Platte, Neb.

Washington, D. C.—The following bills have passed Congress: Authorizing the construction of bridges across the Oconee River at Dublin, Ga.; across the Missouri River at Forest City, S. D.; across the Arkansas River at Little Rock, Ark.; across the Brazos River near its mouth; across the Missouri River between Idaho and Nebraska; across the Arkansas River at Pendleton, Ark., and across the White River, Ark., by the Mississippi & Little Rock Railroad Company.

Canals.—The Juan-de-Fuca Ship Canal Co. has been incorporated at Portland, Ore., by H. C. Walters, John Marshall, Theodore Wygant, F. S. Arnold, Lee Hoffman and William A. Bantz. The first work will be the construction and maintenance of a ship canal between the Straits of Juan-de-Fuca and the waters of Puget Sound, having the western entrance at or in the vicinity of Point Partridge, and the eastern entrance at or in the vicinity of the harbor of Juan-de-Fuca, on Whidbey Island, Island County, Wash.

The Ocklawaha Canal & Drainage Co. has been incorporated at Leesburg, Fla., by A. L. Brown, T. C. Lanier, D. W. Adams and others to construct a canal from Silver River Run, Marion County, to Lake Panasoffkee, Sumter County, and to drain and reclaim contiguous lands. Capital stock, $100,000.

CONTRACTING.

Dredging.—The Board of Docks, New York City, has received the following proposals for dredging at new pier 29, at the foot of Vestry St., North River, and at the foot of 28th St., East River: Atlantic Dredging Co., 21½ cts. per cu. yd. for mud dredging, $1.25 per cu. yd. for crib dredging; W. M. Tebo, 24 cts., $1.25; Morris & Cuming Dredging Co., 25 cts., $1.35. The contract was awarded to W. M. Tebo.

At Baltimore, Md., an ordinance appropriating $10,000 for dredging Jones' Falls has been approved by the mayor.

Dam and Water Power.—Mr. Frizzel, who prepared specifications, etc., for the building of the dam in the Colorado River, at Austin, Tex., to utilize the water power for electric light and manufacturing plants, has submitted his report. He estimates for a 60-ft. dam with crest 1,150 ft. long, 16 ft. wide at the top and 50 ft. at the base, to have a mean capacity for 5,227 H. P., and proposes that 3 water wheels of 600 H. P. should be put in. The estimate for construction of dam and reservoir, gatehouse, pumping and electric plants, mains, etc., is $1,370,000. The issuance of $1,500,000 of bonds for the work is contemplated. For particulars address the Mayor, John McDonald.

Cement.—The following proposals for 1,000 bbls. of Portland cement have been received by the Board of Docks, New York City: Baltjer & Meyerstein, $2.20 per bbl.; Habller & Co., $2.22; James Brand, $2 27; Dickinson Bros. & King, $2.35; E. W. Fisher, $2 48; Chas. H. Spencer, $2.49; Marcial & Co., $2.50; Sinclair & Babson, $2.54. The contract was awarded to Baetjer & Meyerstein.

Dikes.—The following proposals for building dikes in the Thames River, Conn., have been received by Col. D. C. Houston, U. S. Engineer: S. & E. S. Belden, Rock Hill, Conn.: 2,400 tons of rip rap, 95 cts. per ton; 1,350 tons of flat stone, $1.13 per ton; removing and depositing 4,200 cu. yds. of stone, 50 cts. per cu. yd.; total, $5,253.50. Wm. H. Molthrop & Co., New London, Conn.: $1, $1.20, $1.24, $9,228. James Scully, Groton, Conn.: $1.15, $1.30, $1.20, $9,555. H. Twomey, Guilford, Conn., $1.25, $2, $2.50, $16,260.

Broken Stone.—The following proposals for delivering 5,000 tons of broken stone at Sandy Hook, N. J., were received, March 31, by Lieut.-Col. G. L. Gillespie, U. S. Engineer Office, New York: North River Blue Stone Co., $1.24 or $1.49 per ton for stone furnished by bidder, on scows at dock or upon dock; J. S. Howell, 90 cts. or $1 28 per ton, under similar conditions; Brown & Fleming, $1.25 or $1.50 for Harlem River stone, $1.15 or $1.35 for stone furnished by bidder; John E. Walsh, $1.42½ or $1.63½ for Harlem River stone, $1.28½ or $1.43 for stone furnished by bidder.

Steel Pipe, Cement and Lime.—The following contracts for supplies have been awarded by the directors of the State Prison at Folsom, Cal.: Francis Smith & Co., San Francisco, 4,650 ft. of steel pipe, at $1.03, $2.05, $1.10 and 55 cts. per ft. for various dimensions; Folsom Water Power Co., 3,000 bbls. of cement, at $3.92 per bbl.; W. J. O'Brien, of Sacramento, Cal., 300 tons of lime, at $12.75 per ton by rail in carloads, and $9.50 if delivered by wagon loads.

Asphalt Paving.—At Allegheny, Pa., the contract for paving Stockton Ave. has been awarded to Henry Boise,

of the Sicilian Asphalt Paving Co., New York, at $5,116.30. He gives a 10 years' guarantee. Asphalt paving is also to be laid on 3d St.

Public Buildings.—The contract for the new court house and jail at Pierce, Neb., has been awarded to Sprecker & Barris, of Norfolk, Neb.

A new jail is to be erected at Kansas City, Mo. It will probably be 110x90 ft., with two stories. The county court will proceed at once with advertising for the grading necessary before the work of construction can be commenced, and will follow that with advertising for plans and specifications.

A new jail is to be built at Decatur, Ga. W. W. Goodrich, of Atlanta, Ga., is the architect.

The directors of the Erie County Savings Bank at Buffalo, N. Y., have accepted the plans submitted by Geo. B. Post, of New York, for their new building. The cost will be about $750,000.

Sewers.—At New Haven, Conn., contracts were awarded as follows, on April 2, by A. B. Hill, City Engineer: Congress Ave. and Ward St.; A. Brazos & Sons; $3.25, $2.18, $1.75 and $1.45 per ft. for 24-in., 18-in., 15-in. and 12-in. sewers, 90 cts. for 10 in. culvert, $100 per catch basin, $50 per manhole, $12,061.80 total. Orchard St.; A. Brazos & Sons; $3.25, $1.90 and $1.55 for 24, 18 and 12-in. sewers, 90 cts. for culvert, catch basins $100, manholes $47; total, $5,019.50. Mill River St.; Frederick E. Shaw; $1.55, $1.25 and $1.10 for 18, 15 and 12-in sewers, 80 cts. for 10-in. culvert, catch basins $100, manholes $50; total, $2,438.50. Rosette St.; F. E. Shaw; $1.15 and 80 cts. for 12 and 9 in. sewers; manholes $50; $719.50. Dow St.; F. E. Shaw; $1.22 and 80 cts. for 12 and 9-in. sewers; $50 for manholes; $692.80. Cedar St.; F. E. Shaw; $1.20 and 80 cts. for 12 and 9-in. sewers; $50 for manholes; $630. Oakland Park Sts; Anthony Carroll; $1.20 for 12-in sewers, $1 for 10-in. culvert, $100 for catch basins, $50 for manholes, $1,218. Wolcott St.; A. Carroll; $1.50 for 15-in. sewer, $1 for culvert, $100 for basins, $50 for manholes $1,103. Nicoll St.; A. Carroll; $1.50 and $1.15 for 15 and 12-in. sewers, $1 for culvert, $100 for basins, $50 for manholes, $974. Prince St.; A. Carroll; $1.15 for 12-in. sewer $1 for culvert, $50 for manholes, $415.

The Sewer Commissioners, Thompsonville, Conn., have awarded the contract for pipe and pipe laying to John Marsden, of Utica, N. Y., at about $4,800.

The Parks Commissioners, New City, awarded contracts, in March, to J. J. Montgomery and S. F. Pease, at the following prices: In Washington Ave., $6 per lin. ft. for 36 × 26 in. brick sewer; 18, 15 and 12-in. pipe, $1.50, $2.50 and $2 per ft.; house connections, 70 cts; manholes, $70; special manholes, $80; receiving basins, $120; rock excavation, $4 per cu. yd.; concrete, $3 per cu. yd.; timber, $25 per 1,000 ft. B. M. In 152d St.: 36 × 26 in. brick sewer, $6 per ft.; 18, 15, 12 and 6-in. pipe, $3.15, $2.15, $1.60 and 65 cts. per ft; house connections, 70 cts.; manholes, $50; receiving basins, $125; rock excavation, $3 per cu. yd.; concrete, $3 per cu. yd.; timber, $20 per 1,000 ft. B. M.; broken stone, $3 per cu. yd.

The Board of Public Works, Omaha, Neb., has awarded the contract for sewer, in District 97, to J. F. Daley, 8-in. pipe, 63 cts. per lin. ft.; 6-in connections, 50 cts; 4 in., 45 cts.; manholes, $4 per vertical ft.; cast iron, 3 cts. per lb.; ¼ in lead pipe, 70 cts. per lin. ft.; flush tanks, $4.75 per vertical ft.

PROPOSALS OPEN.

Sewers.—Brick and pipe sewers in several streets. The City Engineer, Buffalo, N. Y.

Pipe.—Salt glazed vitrified stoneware sewer pipe. The City Clerk, Los Angeles, Cal.

Road Roller and Supplies.—A 10-ton steam road roller. Also wooden blocks, granite crossings, sand, gravel, cement, castings, etc. E. M. Bigelow, Chief of Department of Public Works, Pittsburg, Pa. April 15.

Sewers.—In several streets. E. Ogden Ross, Secretary of the Contracting Board, Troy, N. Y. April 15.

Sewers.—About 9 miles. Wm. L. Grout, Chairman of the Construction Committee, Orange, Mass. April 15.

Paving.—Laying about 250,000 paving blocks, and setting 7,000 lin. ft. of edgestones. Excavations made and materials furnished by the city. A. Alden Dunbar, Superintendent of Streets, Brockton, Mass. April 15.

Sewers.—About 5,500 ft. Separate bids for pipe and laying. L. F. Smith, Chairman Board of Selectmen, Exeter, N. H. April 15.

Sidewalk.—About 32,000 sq. ft. of artificial stone or concrete sidewalk, with curbing and gutter. A. P. Moore, Bristol, Tenn. April 15.

Sewer.—The Bilbo canal sewer. W. J. Winn, City Engineer, Savannah, Ga. April 15.

Dike.—Pile and stone dike in the Delaware river at Kinkora bar. Major C. W. Raymond, U. S. Engineer Office, Philadelphia, Pa. April 17.

Jail Work.—Cells, gratings and guards. John T. Cooper, Clerk of Committee of Roads and Revenues, Atlanta, Ga. April 19.

Sewer Material.—About 1,000,000 hard body brick. John A. Coleman, Commissioner of Public Works, Providence, R. I. April 21.

Highways.—Grading, improving, and macadamizing roads in Union County. F. A. Dunham, Engineer of County Roads, Plainfield, N. J. May 1.

Bridge.—Building an iron bridge across Nation River, at Casselman. Bridge to be 320 ft. in length; roadway 16 ft. wide, cut-stone piers. Stone and lumber convenient to the work. Bidders tender on their own plans. Two plans of the proposed bridge and specifications are on file. O. Quenneville, County Bridge Commissioner, South Casselman, Ont., Canada. May 20.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered 4 passenger engines to the Savannah, Americus & Montgomery. Also an eight-wheel engine to Brinson & Brinson, of Stillmore, Ga. They are building a consolidation for the Chicago, St. Paul, Minneapolis & Omaha.

The Schenectady Locomotive Works, of Schenectady, N. Y., have an order from the New York Central for 21 eight-wheel passenger engines, cylinders 19 × 24 ins.; 25 mogul freight engines, cylinders 19 × 26 ins., and 29 eight-wheel switch engines, cylinder 18 × 24 ins. The passenger engines will have the American steam driver brake. An engine has been built for the Esquimault & Nanaimo.

The Rogers Locomotive Works, of Paterson, N. J., have an order for 50 mogul freight engines, cylinders 19 × 26 ins. for the New York Central.

Cars.—The Southern Car Works, of Knoxville, Tenn., have an order for 250 freight cars for the East Tennessee, and will put in additional machinery.

The U. S. Rolling Stock Co. is building 500 freight cars at Anniston, Ala., and Decatur, Ill., for the Georgia Southern & Florida. The cars are equipped with air brakes and Gould couplers.

The Buffalo Car Mfg. Co., of Buffalo, N. Y., has orders for 1,000 box cars for the New York Central and 200 stock cars for the Delaware, Lackawanna & Western.

The Pullman Car Co., of Chicago, has an order for 100 electric cars for the Duquesne Traction Co., of Pittsburg.

The Missouri Car Co., of St. Louis, Mo., has an order for 1,000 box cars, equipped with air brakes, for the Chesapeake & Ohio.

The Northern Pacific has just ordered a large addition to its equipment, consisting of 50 new passenger coaches, 100 engines, 1,500 box cars, 300 stock cars and 200 flat cars.

Dump Cars.—The Peteler Portable Ry. Mfg. Co., of Minneapolis, Minn., has brought out some new cars of 5 cu. yds. capacity, for use with steam shovels. The dimensions are as follows: Height above track, 5 ft. 6 ins.; extreme length, 15 ft. 8 ins; inside measure of box, 12 × 8 ft., 15 ins. deep; 18in.-chilled wheels weighing 175 lbs. each; hammered iron axles with 3¾ × 7-in. brass bearings, pedestal and spring over axle; spring draw bars same height as ordinary freight cars; woodwork all white oak; weight of car, about 3 tons; 4 cars can be loaded on a flat car. Four men can dump a train of 20 cars in 5 minutes. Patent spring bumpers are used.

Steel Cars.—The Pennsylvania Co. has asked for bids on steel cars, to be used in ore traffic between lake ports and Pittsburg. If the cars prove a success they will be used also for coal traffic on the company's lines.

Car Lighting.—The Safety Car Heating & Lighting Co. will put in a plant at Atlanta, Ga., for manufacturing and compressing gas to be used in lighting cars of the Georgia Pacific R. R. on the Pintsch compressed gas system.

Car Works.—At Mt. Vernon, Ill., a bonus of $25,000 has been offered to any company that would establish and operate a car factory with a capacity of 10 ordinary flat or box cars per day. In addition to this the Louisville & Nashville R. R. Co. offered the buildings, yards and tracks on the grounds recently occupied by them for its repair shops at a nominal rent for 20 years. Mr. D. O. Settlemier, for many years President of the Litchfield Car Co., of Litchfield, Ill., visited the city, and offered to raise $100,000 of the capital stock if the citizens of Mount Vernon would take $50,000 additional stock.

Brakes.—The American brake is being adopted by the Rio Grande & Western for all the standard gauge engines. One engine was equipped last fall and the brakes will now be put in on the others. The large consolidated engine being built for the C., St. P., M. & O. Ry. at the Baldwin Locomotive Works is also being equipped with the American driver brake.

Corliss Engines.—The Fishkill Landing Machine Co., of Fishkill, N. Y., has delivered a large Corliss engine to New York Central R. R., and is building another of the same size for that road.

Traction Engines.—A traction engine has been built by Mr. John A. Gardner, of Chicago, in which a belt of steel plates 4½ ft. long runs over the two wheels on each side of the engine, forming a continuous track and enabling the engine to run over soft country. It is being used to haul gang plows, and the inventor claims that he can plow 100 acres a day at an expense of less than $12. He also expects to use it for threshing and other farm work, ditching, hauling, railway and canal construction, etc., and suggests that it can be used in the construction of Chicago's great drainage district.

The Berlin Iron Bridge Co., of East Berlin, Conn., has found it necessary to make some changes in the officers, and also in the details of their business. Mr. Burr K. Field, who has occupied for some time the position of Vice-President and Treasurer, has resigned the latter position, and Mr. F. L. Wilcox, of Berlin, Conn., has been elected in his place. Mr. Field will devote his entire attention to the contracting department, which has of late years assumed very large proportions, the company doing a business of between $750,000 and $800,000 per year. All the other departments will be as heretofore under the direct supervision of the President and Chief Engineer, Mr. Chas. M. Jarvis, assisted by Mr. Mace Moulton as Consulting Engineer, and Mr. S. W. Bowles, Jr., Superintendent Engineer. The company is doing a very large business, and has orders on hand sufficient to run its entire plant day and night for the next three months.

The Shiffler Bridge Co., of Pittsburg, Pa., has been formed to own and operate Shiffler Bridge Works. There will be no change in the mangement.

The Pittsburgh Testing Laboratory inspected all the material furnished by various mills for the Merchants' Bridge at St. Louis. As the valuable work done by testing laboratories is very generally ignored in describing our great bridges, it is only fair to state here that this same company has inspected the material for the following prominent bridges, among very many of lesser note: The Poughkeepsie, Cairo, Merchants', Sioux City, Blair Crossing, Thames River, Cuyahoga River New Omaha, Roberts St., at St. Paul, Niagara River, Des Moines, Sault Ste. Marie drawbridge, Dubuque pontoon, etc. A list of railways for which inspection work has been done by this firm includes nearly all the great lines of the United States.

The Carolina Oil & Creosote Co., of Wilmington, N. C., will enlarge its oil plant, as the present contracts exceed the oil making capacity of the works. The contracts now on hand for creosoted piles and lumber amount to about $50,000. The principal contracts now ahead are as follows: Creosoted piles and timber for the Nicaragua Canal Co., for building the pier and breakwater at Greytown; piles for the Southern Construction & Quarry Co., for the custom house wharves at Charleston, S. C.; creosoted lumber for the underground electrical conduits in Philadelphia; about 350,000 ft. of creosoted timber for the new bridge at Chattanooga, Tenn., being built by the Smith Bridge Co.; creosoted piles and lumber for the U. S. Life Saving Station at Humboldt Bay, on the Pacific coast; and all the creosoted timber for the new U. S. dry dock, now under construction at the League Island Navy Yard.

Pipe.—The Glamorgan Iron Works Co., of Lynchburg, Va., has secured a contract to furnish a large quantity of iron piping to Mr. George Vanderbilt for his extensive park at Asheville, N. C.

Curtis & Curtis, of Bridgeport, Conn., manufacturers of pipe cutting and threading machinery for hand or power, have shipped to a Southern house, one of their Forbes patent die stocks for hand power, that has a range from 2½ to 8 ins., right hand, inclusive. While built with such simplicity and lightness that it is perfectly portable, it is so powerfully geared that one man can cut off and thread 8-in. pipe with ease by hand. They will in future build this machine as one of their regular sizes.

The Pond Engineering Co. will furnish a steam plant for the Central Electric Co., Lexington, Ky., consisting of five 75 H. P. Armington & Sims engines, six 125 H. P. boilers, heater, pumps, etc. Power will be furnished for an electric railway and for arc and incandescent lamps. The company will furnish Armington & Sims engines to the Elgin, Ill., street railway, and has received the third order from the Laredo, Tex., Improvement Co. It will furnish everything necessary to make the plant one of the most complete in Texas. A substantial power house will be erected, and a brick stack 100 ft. high. The electric railway and city lighting plants will be driven from this station.

Scows.—Two scows wanted by Ciancimino, 220 South St., New York City.

Metal Market Prices.—*Rails.*—New York, $34; old rails, $24 to $24.50 for iron, $21.50 for steel. Chicago: $35 to $36; old rails, $22.50 to $23 for iron, $19.50 to $21 for steel. Pittsburg: $33 to $34; old rails, $24 for iron, $21 to $22 for steel.

Track Materials.—New York: steel angle bars, 1.75 to 2 cts.; spikes, 2 to 2.10 cts.; track bolts 2.9 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2 cts.; spikes, 2.15, or 2.25 cts. delivered at Chicago or St. Louis; track bolts, 2.90 to 3 cts. with square, and 3.10 to 3.20 cts. with hexagon nuts. Chicago: splice bars, 2.10 cts. for steel and 1.95 to 2 cts. for iron; spikes, 2.10 to 2.25 cts.; track bolts, 2.90 to 2.95 cts. with square, and 3 to 3.05 cts. with hexagon nuts.

Pipe.—Cast iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded, 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent. discount.

Lead.—New York, 3.85 to 3.90 cts.; Chicago, 3.75 cts.; St. Louis, 3.70 cts.

Structural Material.—Chicago: iron or steel angles, 2.60 cts.; tees, 3 to 3.10 cts.; universal plates, 2.50 cts. for iron; 2.55 cts. for steel up to 16 ins. wide, 2.70 for wider steel; steel sheared plates, 2.80 cts.; beams and channels, 3.20 to 3.40 cts. Pittsburg: angles, 2.30 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared bridge plates, 2.80 cts.; universal mill plate, 2.45 cts.; refined bars, 2 cts.; steel plates, 4.25 to 4.75 cts. for firebox; 3.20 cts. for flange, 3 for shell, 2.70 for tank.